Shared Innovation Space for Sustainable Productivity of Grasslands in Europe

Project Acronym: Inno4Grass

Project Number: 727368

Deliverable 2.2.

'Report on case studies for each country, consisting of 10-15 three-page descriptions of each farm and their innovations'

Responsible partners: RHEA (WP leader) and AIA (Task leader)

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Content

1. Introduction

Deliverable 2.2 is related with Task 2.3 'Creation and monitoring of case studies' (M6-M22).

This Task is lead by AIA in collaboration with GLZ, Teagasc, RHEA, IDELE, APCA, LWK, TRAME, AWE, CAH, SLU, NLTO, CNR, PULS, WIR, SV, LRC, CRAN, CRAPDL, CRACVL & CA Vosges, and under the supervision of RHEA.

The objectives and activities of Task 2.3 are described as follows in the I4G project technical annex.

'The objective of Task 2.3 is to describe the practices and systems of a selected number of the most innovative farms (the case studies), their main innovations (e.g. machines, forage mixtures, forage conservation techniques, product processing, marketing, grazing management systems, legume management, animal type), their implementation, results, constraints and achievements.

Case study farmers are mainly selected among innovative farmers interviewed in Task 2.2. They are chosen because they have developed innovative practices and grassland systems. Numbers and types of case study farms per country are presented in Table 1.

Table 1. Number of case study farms per country and farm type.

Country	**Farm types**	**Number of case study farms**
Belgium	Dairy, beef	10
France	Dairy, beef, sheep	15
Germany	Dairy, beef	10
Ireland	Dairy, beef	10
Italy	Dairy, sheep	10
Poland	Dairy	10
Sweden	Dairy	10
The Netherlands	Dairy	10
Total		**85**

An agreement will be concluded with these innovative farmers in order to benefit from their contribution as case studies.

They will be visited in order to describe adequately innovations. The amount and frequency of these visits depends on individual farmers and their availability in time. It is planned to conduct between 1 and 4 visits per farm and per year.'

The technical annex provided also information on data collection.

Task 2.3 endorsed the definition of innovations that was adopted in Task 2.1 with regard to grassland farm management:

'*Innovation in a grassland farm is something original which increases the effectiveness or efficiency of grassland farming management. Innovations are site specific: an innovation in one country can be common practice for years in another one. They can be technical, organizational or at service level*.'

This definition considers that technical and/or organizational innovations can be classified into three categories:

- Innovation in production techniques;
- Innovation in product;
- Innovation in organization (e.g. partnership, value chain).

2. Methodology

Each Inno4Grass partner provided a list of farms and innovation topics to be followed in each case study farm to RHEA. Farms were chosen in priority among those described in farm portraits (Task 2.2). RHEA collected this case study list by email exchanges. The list included also the following information: farm name, country, animal type, case study title and innovation type (Annex 1).

General guidelines for the follow-up of these case study farms have been progressively defined by AIA and RHEA in a participatory approach with all I4G partners. A long debate took place on the type of data that should be collected and on the opportunity to write a standard methodology for this data collection. These discussions took place during General Assembly meetings. They were initiated in Berlin (Germany, February 2017) but were particularly intense during the Leeuwarden (the Netherlands, October 2017) and Sassari (Italy, March 2018) meetings. These exchanges were prolonged by email and skype conversations in the time intervals between the General Assembly meetings. It was concluded that designing a general methodology was not possible because of a too high diversity of innovation types that is a consequence of the I4G wide definition of innovation. It was the responsibility of partners to define their own methodology and to collect data that they considered relevant for their innovations.
Finally, AIA and RHEA synthezised these discussions and sent general guidelines that were still slightly amended after inputs from LRC.

The guidelines for case study farms included:

- a basic questionnaire on the farm (Excel file);
- a more detailed questionnaire (Excel file);
- a collaboration agreement;
- instructions for the case study description and an example.

The **basic questionnaire** is the one used for farm portraits (Task 2.2) but adapted to Task 2.3. Filling this questionnaire was mandatory.

The **detailed questionnaire** includes similar elements than the basic questionnaire but also many others on a wide range of topics. It aims at completing the basic information. It has been designed by AIA, LRC and RHEA. It was optional. The use of the detailed questionnaire was notably recommended in case of very technical innovations. Very often, because of the very diverse nature of innovations, only a part of the detailed questionnaire is relevant for describing a given innovation.

A **collaboration agreement** between farmers and I4G partners has been drafted by RHEA. It is a model that should be fulfilled by partners and signed together with farmers. It is partner responsibility to decide on or not to compensate farmers for his/her contribution. The objective of this agreement is to formalize the collaboration for increasing farmers' commitment in this task.

Instructions were provided to partners for helping them **to describe case studies by drafting the three-page reports** and for harmonizing the lay-out of these descriptions.

Instructions recommended adopting a text structure in four titles or topics:

1) Background of the innovation
   What was the context? What was the problem to solve? What were farmers' motivations?

2) Detailed description of the innovation
   What did the farmer do?

3) Results obtained from the innovation
   What has been improved (workload, profitability, higher production,…) and to what extent?

4) Adoption criteria of the innovation
   In which context and at which condition the innovation can be adopted by other farmers?

During the Paris General Assembly meeting in September 2018, these instructions have been completed at the request of INRA to become "MEAT" compatible. MEAT means: Farmer **M**otivation, **E**lements of Context, Farmer **A**ctions, **T**hreats. This has been decided for facilitating 'cognitive mapping' for analysing systems of practices (Task 4.2). A fifth topics has then be added to the above list. The structure became:

1) Background of the innovation
   What was the context? What was the problem to solve? What were farmers' motivations

2) Detailed description of the innovation
   What did the farmer do?

3) Results obtained from the innovation
   What has been improved (workload, profitability, higher production,…) and to what extent?

4) Adoption criteria of the innovation
   In which context and at which condition the innovation can be adopted by other farmers?

5) Future prospects of the innovation development from the farmer point of view
   What can still be improved? How can it be disseminated? What are the threats?

The lay-out of the three-page reports was also revised at this occasion (October 2018). This last step certainly facilitated and improved the quality of further publication on the IMS and the I4G web site.

The follow-up of case studies started in spring 2018.

All these methodological tools helped a lot for the achievement of Task 2.3 activities.

3. Results

All 85 case studies are now described. They are presented in Tables 2, 3 and 4. Table 2 shows the full list of case studies. Tables 3 and 4 summarize this information by presenting it per country and partner.

Table 2. List of case study descriptions performed per country and partner.

Country	Partner	Case study name
Belgium	AWE	Lentz
Belgium	AWE	Theissen
Belgium	AWE	Darchambeau
Belgium	RHEA	Delobel
Belgium	RHEA	Dubois
Belgium	RHEA	Velghe
Belgium	TR@ME	Faux
Belgium	TR@ME	Willem
Belgium	TR@ME	Convié
Belgium	TR@ME	Cossement
France	APCA/IDELE	GAEC a Razon
France	APCA/IDELE	Pixerecourt
France	APCA/IDELE	Didier Creche
France	APCA/IDELE	Emilie Mace
France	APCA/IDELE	De Chenerilles
France	APCA/IDELE	GAEC Charmee
France	APCA/IDELE	GAEC Basse Cour
France	APCA/IDELE	GAEC Tertre Villeray
France	APCA/IDELE	Jean Luc Gaultier
France	APCA/IDELE	CIIRPO
France	APCA/IDELE	GAEC Saulaie
France	APCA/IDELE	GAEC Bourg Abbe
France	APCA/IDELE	GAEC Bos
France	APCA/IDELE	EARL Barreau
France	APCA/IDELE	Stephan Maigrat
Germany	GLZ	Alter
Germany	GLZ	Amos Venema
Germany	GLZ	Bernd Achgelis
Germany	GLZ	von Runnen
Germany	GLZ	Holthusen
Germany	LWK	Bruns
Germany	LWK	Cramer
Germany	LWK	Rothert
Germany	LWK	Stührenberg
Germany	LWK	Wist
Ireland	TEAGASC	Tim Crowley
Ireland	TEAGASC	Michael Doran
Ireland	TEAGASC	John McNamara

Ireland	TEAGASC	Greenfield
Ireland	TEAGASC	Ger Dineen
Ireland	TEAGASC	Ed Payne
Ireland	TEAGASC	Peader Kearney
Ireland	TEAGASC	Robert O'Dea
Ireland	TEAGASC	Heffernan
Ireland	TEAGASC	O'Donnell
Italy	AIA	Nocentinni
Italy	AIA	Asciano
Italy	AIA	Forletto
Italy	CNR Sassari	Saba
Italy	CNR Sassari	Porcu
Italy	CNR Sassari	Littarru
Italy	CNR Sassari	Pulinas
Italy	Laimburg	Baumann
Italy	Laimburg	Salern
Italy	Laimburg	Schornhof
Netherlands	AERES	de Rooji
Netherlands	AERES	Deinum
Netherlands	AERES	Finnema
Netherlands	AERES	Giesen
Netherlands	AERES	Leinsk
Netherlands	WUR	Bloemert
Netherlands	WUR	Linssen
Netherlands	WUR	Spijkerman
Netherlands	WUR	Van der Voort
Netherlands	WUR	Boer Bart
Poland	PULS	Duda
Poland	PULS	Wójcicka
Poland	PULS	Łuczak
Poland	PULS	Szulc
Poland	PULS	Piosik
Poland	WIR	Kostrzewa
Poland	WIR	Matysiak
Poland	WIR	Kokociński
Poland	WIR	Gorączka
Poland	WIR	Kaczmarekopis
Sweden	SLU	Björketorp
Sweden	SLU	Ekenas
Sweden	SLU	Kårtorp
Sweden	SLU	Siglajvs
Sweden	SLU	Valinge
Sweden	SLU	Jon-Jon
Sweden	SLU	Stommen
Sweden	SLU	Skogsgård
Sweden	SLU	Luttugarden
Sweden	SLU	Ersmarksangarna

Table 3. List of case study descriptions performed per country compared with foreseen numbers.

Country	**Delivered**	**Planned**
Belgium	10	10
France	15	10
Germany	10	10
Ireland	10	10
Italy	10	10
Netherlands	10	10
Poland	10	15
Sweden	10	10
Total	**85**	**85**

Table 4. List of case study descriptions performed per partner.

Country	**Partner**	**Case Study**
Belgium		
	AWE	3
	RHEA	3
	TR@ME	4
France		
	APCA/IDELE	15
Germany		
	GLZ	5
	LWK	5
Ireland		
	TEAGASC	10
Italy		
	AIA	3
	CNR Sassari	4
	Laimburg	3
Netherlands		
	AERES	5
	WUR	5
Poland		
	PULS	5
	WIR	5
Sweden		
	SLU	10
Total		**85**

All the 85 case study descriptions are presented in Annex 2 of this deliverable. They were also sent for publication on the IMS (https://www.encyclopediapratensis.eu/) and the I4G web site (https://www.inno4grass.eu/en/).

These farm descriptions constitute a unique information source on innovations in grassland systems. They cover the large geographical range of the I4G project, from Ireland to Poland on a West-East axis and from Sweden to Sardinia on a North-South axis. Most systems are located in plains and hills of boreal, atlantic, continental and Mediterranean climates. Others are located in mountain areas, especially in continental and alpine climates.

Some innovations focussed on finding solutions for very precise and limited problems by developing very specialized technical tools. Some others were holistic, they consisted in an evolution of the whole farm system from production to marketing, from soil management to consumer contacts.

Some of these innovations will be be presented in videos and synthesized in leaflets that will be soon released on the IMS and the I4G web site through Task 2.5 activities.

They will also be analyzed in WP4. They could be material for Master and PhD thesis which could lead to several scientific publications.

4. Discussion

The description of 85 case studies is a great achievement of the I4G project. It completes the 150 farm portraits, the other important work of WP2.

As Task 2.2, Task 2.3 adopted a participatory approach. At each step of the work, the opinion of partners was collected and considered. This slowed down the task progress but ensured a higher quality work. Interactions between partners occurred by email, by Skype and by face-to-face meetings especially during the General Assembly meetings.

A lot of time was needed for defining a common methodology. This topic was complicated by the extreme variability of innovation types. A compromise has been finally adopted through a simplification of the data collection procedure and a system of two questionnaires.

Finally, the deliverable is published with a delay limited to three months. Compared to Milestone 3 'Case studies set up and operational', the delay has been reduced by four months (from seven to three months). This was possible thanks to a strong commitment and coordinated efforts of partners.

Annex 1. Overview of the selected case study farms.

COUNTRY	ANIMAL TYPE	TITLE OF FARM PORTRAIT OR CASE STUDY	INNOVATION TYPE	FARM OR FARMER'S NAME
Belgium	Beef, Meat sheep	Combining forage mixture, legume management and animal feeding management	Animal type (breed), Animal feeding management, Forage mixture, Grazing management system, Legume mangement, Marketing	Catherine Faux
Belgium	Dairy cow	A coherent system for reducing costs and increasing income	Animal type (breed), Forage conservation technique, Grazing management system	Velghe Jean-Marie and Arnaud
Belgium	Dairy cow, Beef	Grass-fed meat and dairy products, products processed and sold in the farm shop	Animal type (breed), Grazing management system, Marketing	Ferme du Moulin
Belgium	Dairy cow	Change completely your breeding in a few years	Farm system	Marc-André Henin
Belgium	Dairy cow	Combining barn drying – storage , fast rotational stocking and product processing	Farm system, Forage conservation technique, Forage mixture, Grazing management system, Landscape, Marketing, Product processing	Pierre Cossement – Ferme du buis
Belgium	Dairy cow	"Marguerite Happy Cow" Differencied milk cooperative	Farm system, Marketing, Product processing	Ferme du Bois de Herve - Christophe Darchambeau
Belgium	Dairy cow	Barn drying	Forage conservation technique	Birkenhof - Lentz Rainer
Belgium	Goat	Grazing system, complex forage mixture and conserved forage for dairy goats	Forage conservation technique, Forage mixture, Grazing management system	Ferme de la Croix de la Grise
Belgium	Dairy cow, Meat sheep	Combining valorisation of Natura 2000 grasslands areas, product processing and marketing, improvement of grassland	Forage mixture, Grazing management system, Legume mangement, Marketing, Product processing	Bernard Convié - Ferme de Jambjoule
Belgium	Dairy cow	Short-grass grazing	Grazing management system	Theissen Bio-Farm
Belgium	Dairy cow	Combining grazing and automatic milking	Machinery, tools	Jean-Claude Willem
France	Dairy cow	A collective hay dryer in barn	Animal feeding management, Forage conservation technique, Legume mangement	GAEC de la Bos
France	Beef	A sustainable and high-performing system on a living soil	Farm system, Grazing management system	EARL BARREAU Frédéric
France	Dairy cow	Maximal grazing with automatic milking	Farm system, Grazing management system, Landscape	GAEC de la Saulaie
France	Dairy cow	Regular cuts of temporary grasslands	Forage conservation technique	GAEC du Bourg de l'Abbé
France	Dairy cow	Priority to forage quality and grazed grass	Forage conservation technique, Grazing management system, Landscape	GAEC des Méandres
France	Dairy cow, Meat sheep	New species for temporary grassland	Forage mixture	Lycée de Pixérécourt
France	Meat sheep	Finishing lambs with intercrops	Grazing management system	Eloi et Odile Canon
France	Dairy cow, Beef	Using herd dogs to increase work efficiency	Grazing management system	GAEC du Petit Fer
France	Dairy cow	Grazing and economic efficiency in organic production	Grazing management system	Gérard Grandin
France	Dairy cow	Intensification which respect means of production	Grazing management system	GFA La Ferme du Moulin Guérin
France	Dairy cow, Beef	Cellular grazing in Vosges	Grazing management system, Landscape	GAEC de la Charmée
France	Beef	Self-made tool : combine press and bale wrapper	Machinery, tools	Jean-Luc Gaultier
France	Dairy cow	Precocious cutting to maximize proteic rate in forage	Forage mixture	GAEC du Crépuscule
France	Dairy cow	Pasture with milking robot in organic farm	Grazing management system, Machinery, tools	Dominique Bontemps
France	Meat sheep	Outsourced grazing - ecopastoralism	Grazing management system	Didier Creche
Germany	Dairy cow	Site-specific analysis of grassland yields	Forage mixture	Carsten und Klaus Wist GbR
Germany	Dairy cow, Beef	Festuca arundinacea on moor-sites	Forage mixture	Betrieb Thorsten Cramer
Germany	Dairy cow	Drone for grazing-management	Grazing management system	Stührenberg GbR

Germany	Dairy cow	Automated feeding and TMR mixture	Animal feeding management	Henning Rothert
Germany	Dairy cow, Beef	Hay drying with warm air under the roof	Animal feeding management, Machinery, tools, Marketing	Unknown
Ireland	Dairy Farm	Grazing with Monocultures and Mixtures		John McNamara
Ireland	Dairy Farm	Grass Measurement and Grazing with Monocultures and Mixtures		Robert O Dea
Ireland	Dairy Farm	Grazing with Monocultures and Mixtures		Simon Breen
Ireland	Dairy Farm	Setting Up a New Farm for Grazing		Charles Crosse
Ireland	Dairy Farm	Managing Two Grazing Farms		Eddie O Donnell
Ireland	Dairy Farm	Grazing with Monocultures and Mixtures		Michael Crowley
Ireland	Dairy Farm	Grazing with Monocultures and Mixtures		Tim Crowley
Ireland	Dairy Farm	Increasing Grass Output Through Increasing Soil Fertility and Improving Grazing Infrastructure		Glenn Forde
Ireland	Dairy Farm	Setting up Grazing on Hilly Land		William Morris
Ireland	Dairy Farm	Conversion from Beef to Dairy		Michael Doran
Ireland	Dairy Farm	Grazing with Monocultures and Mixtures		Billy Heffernan
Ireland	Dairy Farm	Increasing Grass Output		Padraig Walsh
Ireland	Dairy Farm	Grazing with Monocultures and Mixtures		Liam Irwin
Ireland	Dairy Farm	Grazing with Monocultures and Mixtures		Patrick and Danny Cremin
Ireland	Dairy Farm	Expanding the Farm for Grazing		Peter Cagney
Ireland	Dairy Farm	Grazing with Monocultures and Mixtures		Michael Carroll
Ireland	Dairy Farm	Managing Multiple Grazing Farms		Kevin Twoomey
Ireland	Beef Farm	Adapting Grazing for Suckler Cows		Ger Dineen
Ireland	Sheep Farm	Grass Measurement for Sheep Grazing		Brian Nicholson
Ireland	Dairy Farm	Setting Up a Low-Cost Infrastructure Farm		Abigail Ryan
Italy	Dairy sheep	Use of sewage sludge & new cheese types & direct sale & energy self sufficiency	Animal feeding management, Farm system, Marketing, Product processing	Farm "F.lli Saba" - Pietro and Sergio Saba
Italy	Dairy cow, Dairy sheep	Grazing management with dairy cows and sheep - Reduction of use of concentrates	Animal feeding management, Grazing management system	Professionnal school of Agriculture and Home Economics Salern - Juliane Gasser Pellegrini
Italy	Dairy sheep	Legume species and management & sheep breed & adaptation of seeder to farm soils	Animal type (breed), Forage mixture, Legume mangement, Machinery, tools	Farm Giancarlo Littarru
Italy	Dairy sheep	Legume-based temporary grasslands & forage self sufficiency	Farm system, Forage mixture, Grazing management system	Farm "Santa Barbara" - Bastianino and Roberto Porcu
Italy	Dairy sheep	Legume-based permanent pastures & grazing & management & marketing	Farm system, Forage mixture, Grazing management system, Marketing	Farm " Truvunittu" - Gavino and Giuliano Pulinas
Italy	Dairy cow	Continuous variable stocking - Combination between barn-drying of hay, dehumidifier and photovoltaic plant	Forage conservation technique, Grazing management system, Machinery, tools	Baumannhof/Paul Peter - Mutschlechner
Italy	Beef	Flexible grazing and meadow management system - Regional maketing of meat	Grazing management system, Marketing	Schornhof - Markus Lintner
Italy	Dairy sheep	Use of organic fertilisers & new cheese types & direct sale & energy self-sufficiency	Animal feeding management, Farm system, Marketing, Product processing	Pietro and Sergio Saba
Italy	Dairy sheep	Pasture rotation, sheep genetic selection, consociation of legume and grasslands renovated each year	Animal type (breed), Grazing management system, Legume mangement	Centro Genetico Asciano Farm
Italy	Dairy sheep, Meat sheep	Increase extension of farm, rotational stocking and setting up B&B activity	Animal feeding management, Farm system, Grazing management system	Il Forletto Farm
NL	Dairy	Hay fed dairyfarm	A farming system based on hay fed dairycows (+_ 100 mk) is unique in The Netherlands.	TL Beegden

NL	Dairy	Irish Grazing System	New grazing method	JB Dronten
NL	Dairy	Nature and agriculture fully combined	Development of agricultural system that fully cooperates with nature	BH Rotstergaast
NL	Dairy	Minerals	Supplier De Fryske cheese	AF Warstjens
NL	Dairy	Automatically monitor grazing time in situation of AMS	Montoring grazing time to 1) ensure that cows are outside during a certain period of time and 2) optimise grass intake of cows milked by an AMS	JGK Harfsen
NL	Dairy	Tool voor continous grazing	Development of a feedwedge for continuous grazing is new	WG Vethuizen
NL	Dairy	Maximum grazing with low costs	Non-typical Dutch dairy farm inspired by NZ	AK Wapserveen
NL	Dairy	Grazing on a small grazing platform	Due to scaling, farm size is increasing. Grazing with 7-10 cows / ha grazing platform is challenging	HR Wadenoijen
NL	Dairy	Kurzrasen	New grazing method	JDV Lunteren
NL	Dairy	GrazingFarm: Grazing with a grass/herbs mixture	Including herbs in mixtures can benefit biodiversity, soil health and animal health	SD Sondel
Poland	Beef	Adjustment of feeding system of beef animals to different type of grasslands occurring in the farm	Animal feeding management, Grazing management system	Danuta Wójcicka
Poland	Dairy cow	Application of irrigation on grasslands due to avoid the water deficit in the soil	Machinery, tools	Andrzej Szulc
Poland	Dairy cow	Herbs introduction in grassland sward, grass fed milk and dairy products direct selled from the farm	Forage mixture, Product processing	Grzegorz Łuczak
Poland	Dairy cow	Own constructed aerator for grasslands located on the peat-muck soils characterised by low porosity	Machinery, tools	Mariusz Duda
Poland	Dairy cow	Pivot irrigation system on grasslands	Machinery, tools, Product processing	Michał Kaczmarek
Poland	Dairy cow, Beef	Renovation of flooded meadows using meadow foxtail grass added to standard seed mixture	Forage mixture	Wojciech Piosik
Poland	Dairy cow	Short-term and highly productive grass and legume species in permament grassland	Forage mixture	Jerzy Kostrzewa
Poland	Dairy cow	Slurry tank equipped with a drag hose unit on grasslands	Machinery, tools	Renata Matysiak
Poland	Dairy cow	Sowing grasses and legumes a cross	Legume mangement	Jerzy Kokocinski
Poland	Dairy cow	Westerwold ryegrass as companion crop in establishment of temporary grasslands	Forage mixture	Jakub Gorączka
Sweden	Dairy cow, Beef	A simple system for rotational grazing for heifers and steers	Grazing management system	Anna and Anders Carlsson - Skogsgård
Sweden	Dairy cow	Good N use efficiency with separated slurry and drag hoses	Machinery, tools	Alfred Olofsson, Ersmarksängarnas farm
Sweden	Dairy cow	Grazing – valuable for more milk and less costs	Grazing management system	Per Larsson - Kårtorp farm
Sweden	Dairy cow	Handy Excel spreadsheet for inventory, consumption and ley production	Animal feeding management, Farm system, Forage conservation technique	Lasse Larsson - Jon-Jon farm
Sweden	Dairy cow	Irrigation and manure are important resources in dry areas	Forage mixture, Machinery, tools	nita, Rune and Filip Hägg - Siglajvs
Sweden	Dairy cow	Maximum grazing use through controlled calving	Grazing management system	Martin Johansson - Köinge
Sweden	Dairy cow	Minimal losses when making and extracting silage	Forage conservation technique	Örjan Bergman - Ekenäs farm
Sweden	Dairy cow	Monitoring the amount and quality of silage in tower silos	Animal feeding management, Forage conservation technique	Bengtsson brothers, Valinge
Sweden	Dairy cow	Selling ice - cream adds value to farm - produced milk	Marketing, Product processing	Per Brunberg - Björketorps farm
Sweden	Dairy cow	Three cuts of high - quality ley at the Arctic circle	Farm system, Forage mixture	Viktoria Luttu Wahlberg and Henrik - Wahlberg, Luttugården

Annex 2. Case study farm descriptions: 85 PDF files

See attached files

Maximum milk from fresh grass

Farm: **“Weidebedrijf Aeres Farms”**
Location: **DRONTEN, THE NETHERLANDS**

Background

The Weidebedrijf (PastureBarn), the educational farm of Aeres Hogeschool in the city of Dronten in the Netherlands is an organic farm with a grazing system based on the Irish system: more milk from fresh grass with maximum grazing. Maximum grazing and more milk from fresh grass are realized through an intensive grazing management, strip stocking, and a spring calving herd.

The Weidebedrijf of the Aeres Farm currently has 60 Holstein dairy cows and 28 young cattle. It is not a family business, but it is an independent company that runs for research and educational purposes. The farm has a grazing platform of 45 ha light clay soil with an organic matter content of 4%. The grazing platform is classified as permanent grassland. The grazing platform is fully available for grazing. Next to several grazing cuts, it is on average mowed 1.5 times per year.

The machine park is very limited for Dutch conditions and consists of:

- Enricher
- 60 hp tractor
- Mower
- Rake
- Sprinkler device for spreading straw in the barn
- Manure scraper in the barn
- Milking parlour 2x14 swing over
- Feed cart (25% for the Weidebedrijf and 75% for the Flevoland barn, which is close to the Weidebedrijf)

The work at the Weidebedrijf is done by one employee and several students from different study programs, both from vocational schools and universities of applied sciences.

The barn at the Weidebedrijf is 40 meters by 75 meters large. There are 20 igloos available for the young stock. When the cows are in the stable in the winter, they are checked three to four times a day. The veterinarian visits on average once a month. The calves are dehorned. In some cases, there is more than 10% mastitis in the herd and ketosis occurs in more than 10% of the herd. Acidosis and milk fever are less common, with less than 10% of the herd. Parasites, infections and claw problems do not occur. All cows are artificially inseminated. The cattle are fed once a day. Their ration consists of grass. Concentrates are fed in the milking parlour. The water supply consists of tap water, which is provided via drinking bins both in the stable and on the pasture. The average milk production of the Weidebedrijf is 8200 liters per cow per year and the total milk production is 500.000 liters per year.

Detailed description

The innovation of the Weidebedrijf (PastureBarn) is that it uses a completely different grazing system than the average Dutch farmer. The farm was set up as a low-cost farm in 2015. The philosophy behind the system is that costs are reduced in every part of the farm and in this way, you will be able to earn money as a farmer. Full grazing is a key characteristic of this system. A second aim of the farm is to show the possibilities of this system to young agricultural students and entrepreneurs and show them the benefits of the system. The grazing system of the Weidebedrijf is inspired by turning a maximum amount of fresh grass into milk. The system is set-up to allow the cows to consume as much fresh grass as possible. In order to achieve this, the Weidebedrijf works with a spring-calving herd. The motto is: *Let the cow do the work and use machinery as little as possible*. You could say that the cow is used as a 'contract worker'.

Results

The cows graze for about 22 hours per day during the majority of the grazing season and a little bit less in spring and autumn. The grazing season is about 240 days per year. The grazing platform is divided into plots of approximately 0.8 ha and every day a new plot is offered. The botanical composition of the grazing platform is a mixture of mainly perennial ryegrass and clover. The average yearly grass yield equals about 11 tons dry matter of grass per ha. About 4 tons per ha is cut for silage and about 7 tons is used as fresh grass for grazing of dairy cows. The fertilization consists of solid manure from the stable and slurry in a ratio of about 50/50.

The farmer evaluates the strategy of the Weidebedrijf positively. Results of the innovation are an efficient and intensive grazing system and limited costs. The strategy of the farmer is based on more milk from fresh grass with grazing. This works quite good. The cows currently produce 8200 liters per cow from fresh grass and only a limited amount of concentrates.

Adoption criteria

A very important observation made by the farmer is that when starting a different concept like the current one, it is crucial to stick to the plan. This is difficult at times, but what is the added value of a new concept if the idea soon deviates from the original plan? Perseverance and learning by doing are important.

The innovation is successful on this farm due to a number of reasons that interfere with each other:

- The availability of (scientific) knowledge, since the Weidebedrijf of Aeres Farms is closely connected to Aeres University of Applied Sciences.
- The Weidebedrijf is an educational farm for agricultural students. The farm/innovation has multiple purposes: a normal economic farming purpose but also a purpose for learning processes. The combined functions create the opportunity to innovate.
- The curiosity of the farm management and the students to try new methods.

For other farmers that would like to adopt this innovation, it is crucial to meet a few adoption criteria. The farmer needs to have a large grazing platform (in relation to their number of cows) and needs to have a grazing mind-set. Farmers need to be flexible in order to adjust grazing to fluctuating weather conditions.

Future prospects

From the farmer's point of view, this system is in theory possible in many areas of the Netherlands. However, the corresponding and necessary grazing mind-set is often not available among Dutch farmers. Education is crucial to change the mind-set and to provide scientific knowledge about the benefits of this system. The Weidebedrijf makes a strong contribution in this area by educating a large group of young agricultural students and entrepreneurs.

Organic low-cost farm with own brand

Farm: **"Farmer Bart"**
Location: **Rotstergaast, THE NETHERLANDS**

Background

On the sandy soil in Rotstergaast in the province of Friesland (northern part of the Netherlands) is the farm of Bartele Holtrop settled. Farmer 'Bart' milks over 100 Jersey cows at his organic farm with about 50 hectares grassland in use. Four years ago he started realizing his dream; a farm based on a more natural production process that can last for a thousand years. This means for him that his farm can exist for a long time and not be dependent on others. Next generations must also have the opportunity to have a future on the farm. To achieve this goal, the farmer uses a low cost farming strategy based on maximum use of natural resources.

Farming management

The cows are grazed day and night from March to November. Maximum grazing is the base for the farm and therefore the herd is spring calving. The organic managed grassland is rich of a broad kind of different species of grass and legumes. The most common species and legumes are Italian ryegrass, perennial ryegrass, red and white clovers, goose grass and chicory.

Every 12 , the cows get a new piece of grass at their disposal. This change takes place after milking, because the cows are milked in the field. The farm uses a 2x15 mobile milking parlour. The mobile milking parlour can be moved anywhere by means of a tractor. A big advantage of this is that the soil is protected, because the cows do not have to go back to the shed. During milking, the cows get about 1 kg of grass-based concentrate next to the fresh grass. The organic milk is sold to a cheese factory. Last year, the farm has reached an important milestone. The Jersey milk was processed into an own cheese brand called '' the Tjonger''. The Jersey cows have a milk production of on average 4,200-4,500 liters milk per cow per year, with high levels of fat and protein.

The daily work on the farm is done by 2 AWUs (Annual Work Unit).

The machine park of the company is simple and for daily use only, based on the natural farming system. The machine park consists of:

- Tractor New Holland T6140 with front loader
- Silage cutter
- Feed mixer
- Mobile milk parlor

The land processing, the spreading of manure and the harvesting is done by a contractor.

Financials

The annual costs of the farm activities are low due to the low cost management strategy. The cost price of the production of 1 liter milk is about €0.42. The annual main costs are the maintenance of the milking parlor and the purchase of organic concentrates and feed additives.
The selling price of the milk is on average about €0.65 per liter milk.
The net earnings of 1 liter milk are €0.23, so the farm is in a healthy financial situation.

The farm has a company-website with a lot of information about the activities on the farm: www.boerbart.nl.

The innovation

The grassland innovation of this farm is a low cost and maximum organic grazing system combined with an own brand for the cheese made of the milk. The own brand creates a high added value on a low cost production system.

The strategy of the farmer is based on creating added value for his own produced and branded organic products, based on an intensive grazing system, with focus on a sustainable farming system for the next generation.

The farmer has a farm system with a lot of grazing, with the focus on a low cost price. He tries to go back to the base with his farm and let nature do the work as much as possible. His goal is to produce milk from grass with as few unnatural interventions as possible. To realize this goal the farmer made the choice for the breed Jersey, a spring calving herd and a moveable milking parlor.

The moveable milking parlor has several benefits in his farming system;

- No need for (expensive) paved cow paths
- No loss of structure in grasslands due to walking cows from and to the plot
- Maximum grazing time
- All the plots can be grazed

The farmer is using a fixed rotational system for the grazing to maintain and enrich the organic grasslands. The movable milking parlor is always placed between the border of the just grazed grass and the fresh grass. When the cows leave the milking parlor, they walk directly into te new strip of fresh grass. The grassland management is completely done by the grazing of the cows. The grazing system keeps the grassland healthy and rich with several species of legumes according to the farmer.

Results

The main result of this innovative farm is a healthy financial organic farming system. The lower milk production in comparison with conventional farming is compensated by lower costs and added value. The farmers management creates a unique story for his own cheese brand.

The intensive grazing system used results in a low cost price and a relatively high production, a healthy soil (in balance) and a well-developed organic grassland rich of different grass and legumes species. There is a lot of biodiversity in the grassland. Also a result is the healthy and well-adapted herd to produce milk on this farming system. A final and important result is the inspiration to other farmers to experiment in their own farming system. The inspiring question is how to improve their farming system by using more natural processes.

Adoption criteria

Whether this innovative farming management can be easily adopted by other farms depends on the current situation of that farm and that farmer.

Important farm adoption criteria are:

- The breed of the herd; the typical Dutch Holstein-Friesian breed is not suited for an organic production method or a production method mainly based on grass.
- The availability of enough grassland for grazing.
- The current economic situation (recent investments of the farm housing and milking facilities).

Important farmer adoption criteria are:

- A moral passion and motivated for natural sustainable farming and own branding.
- Open minded – leaving well-known paths.

Future prospects

The system can be further improved by paying special attention to the balance between natural based and economic farming.

Compartmented continuous grazing ("Nieuw Nederlands Weiden")

Farm: **"Hielke and Hanny de Rooij"**
Location: **WADENOIJEN, THE NETHERLANDS**

Background

Hielke and Hanny de Rooij run a dairy farm in the center of the Netherlands. They have around 100 ha on their farm. The majority (67.5 ha) is permanent grassland. This is complemented with 10 ha grass clover, 5 ha mixture of tall fescue and Italian ryegrass, 14 ha/forage maize and 3.5 ha wood/trees. The cows (170) produce on average 9,200 kg milk per year with 4.47% fat and 3.72% protein. The farmers are aiming at the inclusion of grazing in their dairy farm as much as possible. However, the grazing platform of their farm is relatively limited due to a railway and several roads and is only 22 ha. Therefore, they graze 7 to 8 cows per ha grazing platform.

Detailed description

In order to combine efficient grass utilisation and efficient cow production, Hielke and Hanny de Rooij work with a new grazing system, that was recently developed in the Netherlands: compartmented continuous grazing (in Dutch: "Nieuw Nederlands Weiden"). Compartmented continuous grazing is an adapted set-stocking system for stocking rates up to 10 animals per ha in which the cows rotate on a daily basis between six compartments on one platform. Each day, cows are moved to a new compartment and in a period of 5-6 days, they rotate on five or six compartments. The (variable) sixth compartment is cut for silage to increase sward utilisation. So, cows come back in the same compartment after 5-6 days. The average grass height in the compartments is kept constant (8-12 cm) so that daily regrowth is available for intake. The gap between daily regrowth and animal demand is filled with supplementation.

The grazing system was developed a few years ago in the Netherlands as a system that combines high grazing efficiency with ease of labour in dairy systems that have a high stocking rate and a high milk production per cow.

Results

The results of compartmented continuous grazing are very positive on the farm. Hielke and Hanny de Rooij conclude that they can feed a lot of fresh grass and utilise the protein grown on their farm in an efficient way. They achieve a high milk production with the grazing system. Furthermore, the system was easy to implement, did not require a lot of labour / management skills and gave good results with respect to milk production and grass utilisation. The area on the farm that is available for grazing will be optimally used with this grazing system.

Adoption criteria

Compartmented continuous grazing combines the best of two worlds: efficient grass utilisation and efficient cow production. It balances grass intake, grass utilisation and labour needed. It is:

- Efficient: utilise fresh grass for optimal milk production
- Structured: every day both the farmer and the cows know where they stand
- Robust: easy to adapt to weather fluctuations and seasons

Farmers that would like to implement the system need to follow 3 steps.

Step 1 (only once or once a year):

- Divide the grazing platform in a number of equal-sized paddocks (if necessary combine small parcels into one parcel or divide large parcels)
- Number of parcels depends on herd size, size of grazing platform and supplementation level (decision support tools are available)
- Invest in infrastructure to facilitate grazing: water, roadways, fencing, etc.

Step 2 (every 4/5/6 weeks):

- Mow the paddocks that were set for mowing
- Choose your new grazing platform
- Fence the new grazing platform
- Put cattle in pasture at maximum 12 cm grass height

Step 3 (daily):

- Every day a new paddock
- Put cattle out at minimum 8 cm grass height
- Adjust supplemental feeding when needed, depending on grass height of the paddock that cows have just left
    - Grass too long: less supplementation
    - Grass too short: more supplementation

Tips for the best result

- Start early in spring with grazing
- Minimise supplementation to increase fresh grass intake
- Animal manure only for first cut and for paddocks that will be mown
- Organise good paddock access

Future prospects

Compartmented continuous grazing is the solution for dairy farmers that would like to increase the amount of fresh grass converted into milk while spending not too much time on grazing management. The system will be used in many Dutch dairy farms in the near future.

Healthy herb-rich grasslands

Farm: **"Graasboerderij"**
Location: **SONDEL, THE NETHERLANDS**

Background

The organic farm from the family Deinum is located in the northern part of the Netherlands, in the province Friesland. The dairy and beef cows are grazing on grassland with a grass/herbs mixture, for positive effects on animal health, soil health and biodiversity. The farm has a land area of about 130 ha, which is mainly grassland. The grassland is grazed by 160 dairy cows (Holstein-Friesians) and 75 corresponding young stock and by 35 beef cows (Herefords) and 67 corresponding young stock. The average milk production of the dairy cows is 5,800 kg milk per cow per year. The farmers practice strip grazing for 8 months a year in order to obtain a high grass utilisation.

The farm has been working with herb-rich grasslands for a long time. Next to herbs, the grassland contains several grass species, like rough meadow-grass, timothy, meadow fescue and also perennial ryegrass. Since three years the farm works completely biodynamic. Neither using antibiotics nor artificial fertilizer requires a well-balanced grassland with herbs to keep the cows and the soil healthy. This is now even more important.

Detailed description

The main species in Dutch grasslands is perennial ryegrass. Including herbs in Dutch grasslands is innovative for the Dutch conditions. It can be done for e.g. attracting meadow birds or improving animal and soil health.

Every three years the farmer checks the botanical composition of the grasslands and decide whether reseeding is necessary. If so, the farmer sows the new seeds early in the year with a machine for fine seeds. After that the cows spread the seeds into the soil when they graze the pasture.

Results

The farmer is very positive about the inclusion of herb-rich grasslands in his farming system and will continue to work with this system. Main benefits are the fact that the herb-rich grassland helps to keep both the cows and the soil healthy.

Herb-rich grasslands have been previously analysed via a SWOT-analysis:

- Strengths: improved animal health, better soil quality, higher biodiversity (e.g. insects and meadow birds), lower costs
- Weaknesses: lower protein yield per ha, lower forage quality, possibility of 'poisonous' herbs
- Opportunities: system valued by society, higher milk price, higher biodiversity, financial compensation for more nests of meadow birds
- Threats: inconsistent regulations and subsidies, not all herbs are suitable for all soils (for example due to pH)

Adoption criteria

Based on the SWOT-analysis, it is clear that this innovation cannot adopted by all farms. It fits perfectly in organic farms, but also in nature-oriented farms and farms that are not very intensive.

Future prospects

Herb-rich grasslands will further increase in the Netherlands. Not only due to their positive effects on cow health and soil health, but also due to the fact that the Dutch dairy chain is stimulating an increase in biodiversity. The Dutch farmers association and the Dutch dairy industry developed four goals for a "sustainable dairy chain". One of them is in particular related to herb-rich grasslands and biodiversity: "*The dairy farms develop with respect to animals, surroundings and the environment*". (https://www.duurzamezuivelketen.nl/en/themas/protecting-biodiversity-and-the-environment/

Herb-rich-grasslands can be further improved by breeding of grass and herb species and by carrying out research on the management of herb-rich grasslands, the benefits of herb-rich grasslands and on optimal seed mixtures.

GraasBoerderij

Fertilisation for soil improvement

Farm: **"Leeuwerikstate"**
Location: **WARSTIENS, THE NETHERLANDS**

Background

The farm from Finnema is located in the northern part of the Netherlands, in the province Friesland. Finnema milks around 200 dairy cows on an agricultural area of 116 ha. This area is all grassland, bot conventional grasslands (around 95 ha) and natural grasslands (around 21 ha). The soil type is partly clay and partly peat. The dairy cows graze around 7 months per year. The Holstein-Friesian dairy cows of Finnema produce on average 8,800 kg milk per cow per year. Finnema is especially interested in the soil quality. He focuses on the chemical soil fertility of his grassland to get a higher yield. The fertilisation plan of the Finema farm is based on the so-called "Albrecht-method".

Figure. The milk of the farm of Finnema (left) is processed into De Fryske cheese (https://www.defryske.frl/boer-albrecht/

Detailed description

The “Albrecht-method” was developed by the American soil expert William Albrecht. William A. Albrecht (1888-1974) was an authority on the relation of soil fertility to human health. Dr. Albrecht saw a direct link between soil quality and food quality - a link which necessarily lent itself to human health. His work made clear that health stems from the soil. He drew direct connections between poor quality forage crops, and ill health in livestock. He developed base-level requirements for soil nutrients which are still being used.

Albrecht believed in getting optimum soil conditions by using soil analysis and his mineral balancing principles. Plants will then use nutrients according to their needs. This was later called the Base Cation Saturation Ratio (BCSR) theory of soil interpretation.

Albrecht revealed the importance of the balance equation, that it isn't enough to have nutrient to soil connections, it is the ratio of one element to another that counts. Albrecht's insight further revealed that an ounce of prevention in the form of balanced plant nutrition from fertile soils is better than a pound of cure using dangerous poisons.

In a nutshell, Albrecht strongly believed there can be no high quality nutrition in foods without high soil fertility where the foods are grown or raised. Almost by definition, high fertility includes optimum levels of both organic matter and a complete, balanced array of nutrient minerals.

The Albrecht method is a fertilization method based on the analyse of the soil for the elements magnesium, calcium and potassium. The idea is that the right proportions of these elements create a fertile soil for the grass. The focus for fertilization is on the chemical proportions in the soil and not on the needs of the crop.

Results

Finnema is enthusiastic about the use of the Albrecht-method. He believes it improves the yield through focus on the soil fertility. It increases the amount and the quality of the grass production while using less fertiliser (in particular less calcium ammonium nitrate).

Adoption criteria

This innovation will only work if the farmer is really interested in soil fertility and if the farmer believes in the strength of the Albrecht-method and is willing to act to the principles of this method.

Future prospects

This innovation will be used in a limited number of farms.

Opimum balance between grass allowance and grass intake

Farm: **“Wilry Giesen”**
Location: **GELDERLAND, THE NETHERLANDS**

Background

Wilry Giesen (39) has a dairy farm together with his father Willy (65). The 110 dairy cows are milked with an automatic milking system and produce on average 9,500 kg per animal per year. The herd includes Holstein Friesian, Brown Swiss, Fleckvieh and Swedish Red. The area of the farm is 47 ha of clayey/loamy soil. About 39 ha of the total area is permanent grassland with a mixture of perennial ryegrass and white clover. The remaining 8 ha is used for forage maize. The cows graze approximately 6 months per year. The farmer aims for a successfully and efficient grazing period. The strategy of the farmer is based on reducing costs and a more efficient use of the fresh grass. He uses a continuous grazing system.

Detailed description

There are hardly any decision support tools (DST) for systems with continuous grazing. Therefore, the farmer measures grass height in his parcels on a regularly basis. This provides insight in the grass growth of his particular farm. Measuring grass height is not often done in the Netherlands. The measurements give the farmer insight in the amount of additional feed he has to provide in the barn for an optimum use of the fresh grass from grazing. For an optimum use of the fresh grass, the (supplementary) feed in the barn has to be adjusted to the grass growth and the grass intake of the cows. Based on measuring grass on a regulatory basis, a DST for continuous grazing was developed (the so-called "Grazing window"; in Dutch: grasvenster).

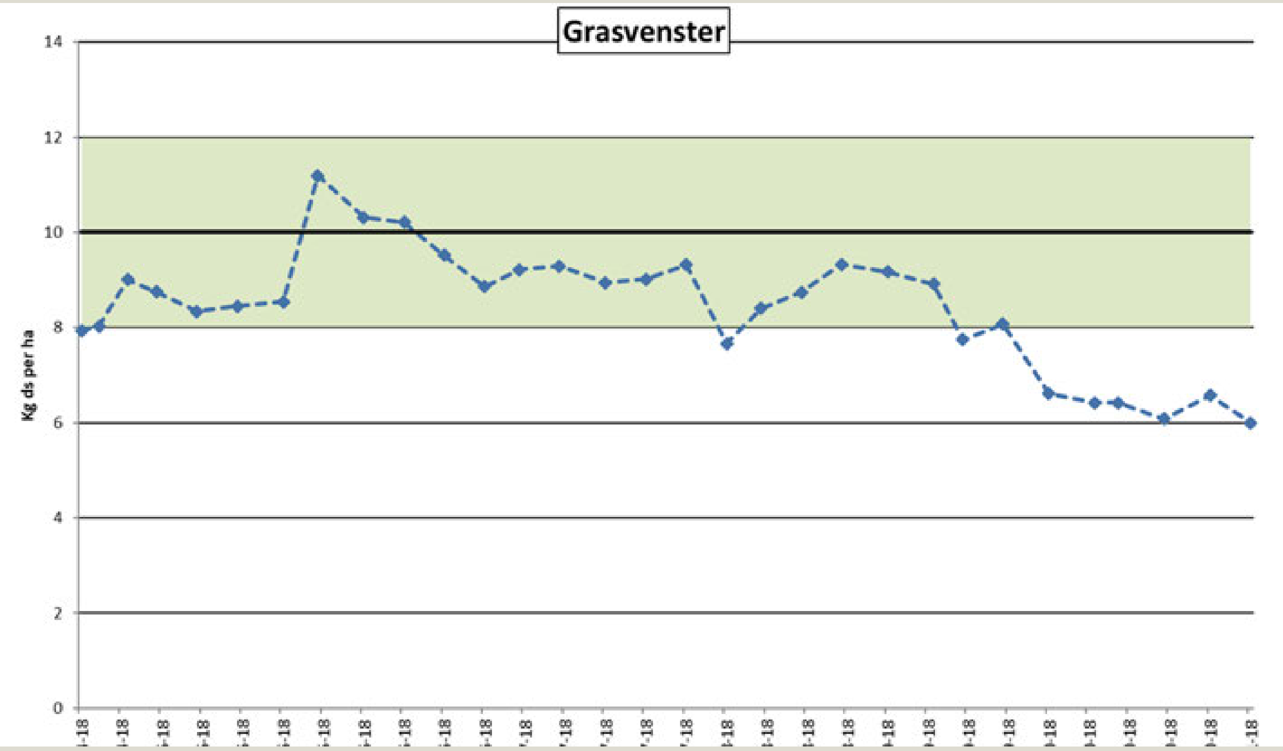


Figure 1. Example of a so-called "Grazing Window". The grass height is followed during the grazing season and the aim is to keep the grass height in a target area. In this example, the target area is between 8 and 12 cm grass height.

Results

The Grazing Window is a Decision Support Tool that helps to provide insight in the optimal use of a continuous grazing system. The aim is to strive for a particular grass height (the green bar in the above picture).

Adoption criteria

The innovation is useful for farmers that want to control their grazing system and their cows. They should be willing to measure grass on a regulatory basis, for example once a week. Furthermore, they need to be willing to adjust their management to the results. They could either adjust the grazing area, the grazing time per day and/or the ration of their dairy cows. The Decision Support Tool "Grazing Window" is useful for farmers that practice continuous grazing.

Future prospects

Continuous grazing has been further developed in the Netherlands into the so-called compartmented continuous grazing. Since this is an easy to implement grazing system with good results, more and more Dutch dairy farmers are using it. The "Grazing Window" can be a very good tool for these dairy farmers to support their daily management. It will be further developed in the project Amazing Grazing (www.amazinggrazing.eu). The tool can be further improved if predictions of grass growth are incorporated in the program in the near future.

Digiwei

Farm: **"Lensink"**
Location: **AALTEN, THE NETHERLANDS**

Background

At the farm of Johnny and Rianne Lensink, 55 dairy cows are milked by a milking robot. Free cow traffic is applied on the farm and it is therefore difficult to determine the amount of grazing per cow per day. The Lensink family wants to prove that the cows are grazing in order to meet the criteria for obtaining a grazing premium. Dutch dairy companies offer a grazing premium of 1-2 cts per kg milk to farmers that practice grazing for at least 6 hours a day and for at least 120 days a year. More and more, it will be obliged by the milk processors, to really prove that the cows are graze during that time period. Therefore, the Lensink family is now experimenting with Digiwei. This is a Bluetooth system that measures the grazing hours for each individual cow. The farm has four receivers that register whether a cow is walking inside or outside the barn in the field.

Detailed description

The majority of the inhabitants of the Netherlands like to see cows outside the stables, because cows are part of the Dutch landscape. To stimulate farmers to let cows graze outside, they get an additional bonus on top of the normal price of a liter milk. To get this bonus,

IoT Farm B.V.
INTERNET OF THINGS OPLOSSINGEN

cows must be outside in the field for at least 120 days per year and at least 6 hours per day. For farmers with cow-traffic that is managed by a milking robot, it is difficult to prove that cows were outside in the field for that specific time. This is why several companies developed systems that measures the time that the individual cow is outside in the meadows. The system of the Internet Huis (Digiwei) is based on a tag that's attached to the cow and receivers along the path where cows go to and from the meadows. (https://innovation-awards.nl/en-us/innovation/digiwei)

Figure 1. Set-up of Digiwei (https://www.iot-farm.nl/)

Results

The family Lensink tried the system. Based on the results thus far, they have mixed feelings. The system would be far more beneficial if they would be able to use the data from the system for their daily management as well.

Adoption criteria

This innovation will be useful in situations of doubt whether or not farmers meet the criteria of the grazing premium. A system like Digiwei will deliver the real data on the amount of grazing of each individual dairy cow.

Future prospects

This innovation will be used in a limited number of farms only, especially in situations with high grazing intensities and doubt whether or not the criteria for the grazing premium are met.

The prospects will increase if the data can be used in daily management as well. Research at Aeres University of Applied Sciences showed the following: After conducting interviews with dairy farmers it turned out, that there was a lot of demand to be able to do more with the digital measurement system, and farmers mentioned many possible opportunities. However, it also turned out that the users had very little experience with the digital measurement systems, so they could share little experience. An analysis of data obtained by 6 commercial farms with a digital measurement system showed that there were many differences between the farms, and the pasture system had a lot of influence on these differences. The variation in pasture times between the cows was also striking and could be promising in daily farm management.

Hay feeding system

Farm: **"Linssen"**
Location: **BEEGDEN, THE NETHERLANDS**

Background

The farm is located in Beegden. Here lives Twan Linssen together with his wife and two children. Three years ago, the farm had to move 100 meters to create more space for the river. The Linssens used this opportunity to build a new stable and start with a new system. The farm is now an organic dairy farm. The new stable is designed to feed the herd with hay only. The current capacity of the farm buildings is 100 cows. Now, the farm has 65 Holsteins crossed with Fleckvieh cows. Two De Laval milking robots milk the cows. Due to the robots, no foreign staff is needed on the farm. The status of the farm area (in total 124 ha) is shown in the table below.

Farm area (hectares)	Status	Soil type	Organic matter percentage
18 ha	Owned	Light clay	11%
85 ha	Rented	Light clay	11%
21 ha	Natural land	Light clay	11%

The dairy cows graze on the grazing platform of 18 hectares near the buildings and the young stock grazes on the 21 hectares of natural land.

The machine park consists of:

- Front mower
- Self-loading silage wagon
- Rake

- Grass harrow
- Cattle transport wagon
- Fertilizer spreader (not in use)

The barn has a total area of 2272 m^2. Half of this area is used for housing livestock and the other half for storing hay and wood chips. The barn is naturally ventilated. The water supply is via tap water and water troughs. The grazing platform has been irrigated during the dry summer season of 2018.

Some costs of the farm are given in the table below. Since it is an organic dairy farm, there are no costs for chemicals and artificial fertilizers.

Type of costs	Annual costs
Fuel	3000 euro
Medicines	200 euro
Grassland management	2700 euro
Water	2700 euro
Electricity	12000 euro

The milk price of the farm was 49.5 cents in 2017. The company could not make a profit in 2017 since the phosphate rights system was introduced in the Netherlands and the number of animals is still low compared to the capacity of the barn. Currently the only product to sell is milk. The entrepreneur is considering creating camping places next to the farm to attract tourists and get an additional income.

The grazing platform is 18 hectares. Each day the cows get a new parcel of about 1 ha. The grass mixture consists of tall fescue, timothy and perennial ryegrass (so called Greenspirit mixture). This mixture has been sown on both the grazing platform and on the more remote parcels. The grass production was only 5-6 tons per ha in the year 2018. This was mainly due to the drought. Normally the yield is between 8 and 9 tons. 30% of the grass yield is for hay production, 60% is grazed and the last 10% is put into bales. Every year the cows graze for about 250 days. They can go outside 24 hours a day.

The herd consists of 65 dairy cows and 45 young cattle. The manure is separated into two components. The solid fraction is used as bedding material in the cubicles. The liquid fraction is used as a fertilizer. The fertilization consists of slurry only. Animal health is good at the farm. There is no acidosis in the cattle, also less than 10% ketosis, (sub clinical) mastitis and milk disease. There are no parasites or infections. In 2017, there were only 3 animals with claw problems. All animals are artificially inseminated. The cattle are fed twice a day with a ration of hay only. The total milk production is 442,000 kg milk per year and 6800 kg milk per cow per year.

Detailed description

Feeding hay is something that hardly occurs in the Netherlands. In countries like Austria, it is more common. The farmer built a new farm three years ago and then used the latest techniques for the hay feeding system. The layout and scale on which the system is applied is new in the Netherlands.

In the barn, there are two large bins created in which the hay is dried. This is done with heat that is collected under the roof and heat released during the combustion of wood chips. The hay is delivered to the cows twice a day with a crane hanging at a rail in the ridge of the barn.

The farmer wanted to distinguish himself from other Dutch dairy farmers. With the feeding of hay only, he can do this. Furthermore, he wanted to improve both animal health and the quality of the product, milk. By feeding only hay in the barn, the cows have a lot of access to roughage and the intake of roughage works positively on the digestive system of a ruminant. The milk that is produced contains amino acids that are easier to absorb by the human body, making the product healthier for people.

Results

By feeding hay in combination with extensive grazing, the health of the cows on the farm has improved. Linssen deliberately opted for a large proportion of fresh grass, because grazing contributes to the health of the livestock and when the cows graze the grass, no energy is needed to make hay.

So far, the concept has no influence on the company's turnover, because the milk is not yet sold separately. It is the intention of the farmer to start a separate milk flow, e.g. Hay Milk. However, more milk is needed to make the processing of a separate milk flow cost-effective.

Adoption criteria

The farmer now has a group of 6 farmers in the vicinity of the farm that are interested in the concept. These entrepreneurs see the positive results of feeding hay only in the barn and are interested in the idea of setting up a separate milk flow in order to distinguish themselves from other farmers and get a higher milk price.

Future prospects

The biggest challenge for the farmer is the setup of a separate milk flow. A separate milk flow would allow the farmer to translate the new system of hay feeding into a higher turnover for the farm. Another challenge is to ensure enough yield so the cows can really be fed hay only during the whole winter.

New Zealand in the Netherlands

Farm: **"Spijkerman"**
Location: **WAPSERVEEN, THE NETHERLANDS**

Background

Auke Spijkerman is an organic dairy farmer from Wapserveen. Wapserveen is located in the north of the Netherlands in the province of Drenthe. Spijkerman and his parents milk 85 dairy cows. The farm has 70 hectares of land, of which 48 hectares are owned and 22 hectares are rented. Of those 70 hectares, 43 hectares are grasslands suitable for grazing. The soil type of the 70 hectares is partly peat and partly sandy soil. The organic matter content is very different on the plots, which is between 4.5 (sandy soils) and 22% (peat soils).

The 85 dairy cows on the farm are all crossbreeds. Spijkerman crosses with many different breeds, such as MRIJ, Fleckvieh, Jersey, Holstein, Brown Swiss and Swedish red. The cows on the farm produce on average 6200 liters of milk per cow per year. In total, the cows are good for a milk production of 500,000 liters of milk per year.

The machine park of the entrepreneur is not big, but sufficient for this way of farming, the machine park consists of:

- Mower
- Hay tedder
- Grass rake
- Self-loading silage wagon
- 2 tractors
- Land roll
- Overseeder
- Cambridge roller

The area of the barn is 1200 m^2; next to the stable is the building for the milking parlour that was renewed last year. The size of the building for the parlour is 300 m^2. The new milking parlour that was built last year is a 2x16 swing-over from Dairymaster. With the 85 cows that Spijkerman milks, milking is then finished in 1 hour including cleaning. On the farm, there is also a stable for the calves of 150 m^2. Both the stable for the cows and the stable for the calves are ventilated by natural ventilation.

At this farm, the costs are very low and that is the goal of the farmer. The costs for fertilization and spraying are zero since the farm is organic. For the rest there are the costs for fuel and seed, which are about 8900 euros per year for this farm. The medication used on the farm costs about 1000 euros per year. The low costs for medicines are partly because cows have few diseases. The company does not suffer from problems with the abomasum in the cattle, also less than 10% ketosis and mastitis. Furthermore, there are no problems with parasites or infections. The farm of Spijkerman does suffer from subclinical mastitis, more than 10% of the cows encounter this and the farmer is working hard to reduce this problem. The costs for water and light are around 8200 euros every year. With an organic milk price of 49.5 cents per liter of milk, a net margin of 34 cents is reached.

In order to notice sick cows in time, the farmer checks the cows 3 times a day. He sees the cows twice a day in the milking parlour and in the middle of the day he usually also checks the cows. The veterinarian does not visit the farm very often, on average once a month, during the calving season a little more often than the rest of the year, but on average once a month.

Detailed description

The aim of the farmer is to have the cows produce as much milk from grass as possible and he does this by applying the NZ grazing system. He uses a system of strip grazing where the grass allowance is exactly the kilograms of dry matter that they need every day. The aim of the farmer is to have the cows graze as many days per year as possible. In the spring and autumn, Spijkerman supplies the cows with fresh grass in the barn, which he retrieves with his tractor and loading wagon. For the rest there are not many machines on the farm. An important component of the NZ grazing system is a spring-calving herd. Spijkerman follows a different approach and has decided to split the herd in half, one half calves in February and the other half six months later. In this way, cows that are not in calf in summer get a second chance a half year later.

Results

Grass production at Spijkerman's farm is about 10.5 tonnes dry matter per hectare per year, about 3 tonnes of this 10.5 tonnes are mowed and the cows graze the remaining 7.5 tonnes. Grasslands of the farm contain many herbs, mainly clovers and narrow plantain. In addition, grasses have been sown, such as perennial ryegrass and Timothy. Last year the number of grazing days amounted to 237 days of pasture with about 21 hours grazing a day. The average number of grazing days in the Netherlands is about 180 days. It is common to practice grazing during the day only.

Adoption criteria

Other farmers who may want to adopt this system must realize that it is not easy to copy. First, this NZ grazing system must fit the farmer and the farm. The farmer should be able to extensively graze cows and to enjoy it. A suitable grazing platform is needed; it should be big enough to graze the cows during the grazing season. The NZ grazing system is a low cost system and does not go for the highest milk production. When a farmer likes to see a very high milk production, this system is not a good idea. Based on grass only, high milk productions are not expected. However, if a farmer is interested in low costs, this grazing system will be a good option. A farm like that of Spijkerman would be perfect.

Future prospects

For the future, Spijkerman considers it important not to get too many dry summers like in 2018. In these years, grass growth is less and the success of the whole system depends on a good grass growth. As the farm of Spijkerman is organic, buying grass is very expensive and this is therefore not desirable to maintain the low cost price. When it is too dry for too long and there is not enough grass, the cows will have to go back into the stable in the middle of the summer.

Kurzrasen in Lunteren

Farm: **"Van der Voort"**
Location: **LUNTEREN, THE NETHERLANDS**

Background

Jan Dirk van der Voort is a dairy farmer in Lunteren with 85 Jersey cows. Lunteren is located in the middle of the Netherlands. The type of soil in this part of the Netherlands is sand. The philosophy of Van der Voort is to work close to nature and only use natural resources. The entrepreneur processes on-farm the milk of the dairy cows into cheeses. The cheese is entirely made, matured and traded in-house. It is sold under the brand Remeker (https://www.remeker.nl/). All the milk that the cows produce is for the preparation of cheese and not even one liter of milk has been sent to the milk factory for the last 15 years. By keeping the cows as natural as possible, the taste of the cheese is of a high level. Cheese is the income of the company, so the entrepreneur thinks it is important that the taste of the cheese is perfect.

The farm of Van der Voort is an organic farm and has 55 hectares of land in use. The grazing platform is 35 hectares. In principle, the cows graze day and night for about 200 days a year. An additional 65 days a year, the cows can graze only during the day. In this period, they are getting used to eating fresh grass. During the 200 days, the cows produce milk from grass only; they do not get supplemental feeding. The Van der Voort farm has a milk production of on average 5000 liters milk per cow per year, with 5.8% fat and 4.35% protein.

The machine park of the company is simple, but modern. With today's operations, machinery that is more extensive is not necessary. The machine park consists of:

- Tractor 80 hp
- Tractor 60 hp
- Telehandler

- Mini shovel
- Blade bar
- Grass rake
- Mixer wagon 8 cubic meters
- Straw blower

The farm employs 6 FTEs of staff. The entrepreneur wants to be good for his staff and handle and pay them well. This works, because there are little changes in staff at the farm.

The annual costs of the farm activities are low. €9000 is needed annually for fuel and seed. There are no medicine costs, since the entrepreneur wants to produce milk in the most natural way. The electricity and water usage at the farm is, however, high: € 26,700. This is because the processing of cheese to milk requires a lot of electricity and water. In the end, the Van der Voort farm has a high milk price of € 2.03 per liter of milk. At the bottom of the line, when the costs of the farm and cheese making activities are subtracted, the entrepreneur earns almost 60 cents per liter of milk, which is a huge profit for Dutch conditions.

Jan Dirk van der Voort focuses on the soil quality at his farm. The majority of the grasslands on the farm is more than 30 years old and has never been reseeded. Grasses have a high root depth and the harvested grass is of high quality. Only when new grasslands are bought, they are ploughed and sown. The entrepreneur always wants to expand the farm, so he tries to buy all the land that comes available for sale in the neighborhood. In this way, he aims to become even more self-sufficient in forage and to provide his cattle with homegrown feed. According to the entrepreneur, a good and a healthy soil is the basis for good farm management. The cows are the evidence; they do not suffer from acidosis, ketosis, milk fever, mastitis or other diseases. They also hardly have claw problems. All these factors ensure a pleasant and easy way of working.

Detailed description

The grassland innovation of this farm is the grazing system: kurzrasen. Kurzrasen is originally a German grazing system whereby cows graze the sward at a target height of 4 centimeters. This is much lower than common in the Netherlands. With kurzrasen, cows are grazing the same paddock every day. Grass tillers have a more prostrate growth, whereby a maximum of photosynthesis uptake can be achieved.

Next to kurzrasen, there are a number of other innovations at the farm. Van der Voort aims to fully rely on the power of nature. He uses this concept in branding his Remeker farm cheese. It is a natural product created as part of natural processes only. No use of antibiotics or other medicines, no pesticides, no artificial fertilizer, no slurry. Cows are free to make their own choices. The calves graze together with the cow. The cows graze as much as possible and are only inside during milking and in the winter. All cows keep their horns during their entire lifetime.

The farm is not connected to a dairy factory. The entrepreneur has deliberately chosen to leave this system, which is the system in which the majority of the Dutch dairy farms function. It is remarkable that what is done on this farm, and what is seen as innovative, is in fact not only very profitable, but also a return to the former basis of agriculture. Kurzrasen is relatively new, but it does fit in this natural farming system.

The farm used to practice continuous grazing with relatively low sward target heights, but since the farm started with Kurzrasen three years ago the cows graze the grass even shorter, to 3 to 4 cm. In this way the grass quality increases since the energy content of the grass is higher (no stemmy material).

Results

The results of the farm are impressive. The farm does not have the highest milk production, but it has a high turnover and profit per liter of milk, and both livestock and land are healthy. There are hardly any problems with diseases on the farm. Claw problems do not occur. According to the farmer, this is a result of the fact that the cows still have their horns. The theory behind this is that a cow gets the minerals it needs from the horn instead of the claws. The claws are thus spared. The farm has a high grass yield given the fact that it is organic. This may be the result of the kurzrasen system, because the cows damage the ground less, but it may also be related to the healthy soil and the high soil organic matter content as a result of fertilization with solid manure only.

Adoption criteria

In the Netherlands, farmers are becoming more and more aware of the extra value in grass quality that could be reached with a system like kurzrasen. However, there is not yet a lot of information available about this system and therefore some dairy farmers only use it. In theory, the system could be applied to every farm where the cows graze.

Future prospects

The challenge of kurzrasen is to realize the highest possible grass production by improving the soil. Showing the good results of the system to other farmers may lead to further adoption. The threats of this innovation are limited and the associated investment costs are small. There may however be a risk in grassland management. If the grassland is not managed optimally, the financial benefits will decrease.

Interaction between grassland use and genetic improvement of the flock:
"Sustainable and targeted management of grassland"

Farm: **"Asciano farm"**
Location: **ASCIANO (SIENA) ITALY**

Background

Asciano farm is a dairy sheep farm located in Asciano (Italy) hosting a genetic center for dairy sheep selection. Selection objectives are targeted on single characters (milk production, protein milk content, reproduction attitude, etc.) but also on multiple characters and on interactions between environment and production.

Asciano is a reference farm for many breeders in Italy, both for improving the genetic level of their flock and buying top genetic rams and as a demo farm from where to get information on optimal nutrition, good management practice and animal welfare.

In the last decade, one of the main goals of this farm was optimizing the interactions between grassland use (especially grazing) and milk quality and yields. Particularly, it aimed at increasing quality of milk (e.g. its aptitude to be transformed in cheese), in terms of fatty acids, protein and CLAs contents, by exploiting the nutritional quality of grassland.

To achieve this goal, it is important to have a flock of grazing animals that could be able to maximize the use of grassland avoiding an over-consumption of pasture and its negative consequences.

Detailed description

Asciano Farm started to focus on the main requisite to achieve good results, namely to have a correct manage of grazing system and flock rotation nucleus, according to the biomass availability, to the season and to the number of heads per hectares.

Based on management decisions and forage species availability, farm's grassland is divided in permanent (*Lolium perenne, Trifolium pratense, Festuca arundinacea, Medicago sativa*), used especially for hay production, green forage and also as a pasture, and temporary grassland (*Avena sativa, Hordeum vulgare, Sorghum vulgare, Trifolium incarnatum, Hedysarum coronarium*) destined to hay production, silage and grazing. The rangelands are both natural and cultivated, composed by a large biodiversity of grasses/legumes typical of center Italy.

To monitor grassland management and the quality of biomass, analysis on permanent and temporary grassland are periodically made, are analyzed: crude protein, D.M., ADF, NDF, net energy, total digestible nutrients, moisture, minerals.

In 2012 a new agronomic plan has been introduced to renovate part of grassland every year (every two years only for *Hedysarum coronarium*) in order to increase the annual production of Fodder Units and decrease the cost for off-farm forage purchase.

The replacement of old species with the new species and varieties has been considering their adaptability to the pedoclimatic conditions of soil of Asciano farm.

A forage of new introduction is *Hedysarum coronarium*, managed as monoculture, without chemical fertilization, capable to yield over 7 tons per hectare of forage and to be grazed after the first cut of the year.

Together with *Hedysarum coronarium*, *Trifolium incarnatum* has been introduced, sown annually, both grazed and for hay production. *Trifolium incarnatum* is a catch culture, it does not need irrigation and achieve value of fodder unit of 38/100 kg.

Both these legumes are cultivated applying the "minimum soil tillage" concept, reducing deep soil processing to conserve soil fertility and structure. Inoculation with rhizobium is applied to support germination, increase carbon fixation, and forage production.

To achieve good results, also quantitative productions of grasslands, which should remain as constant as possible over the years, are constantly monitored; this is one of the reasons why the temporary grassland surface has been increased and used with the cultures above described.

In Asciano are reared two Italian dairy sheep breeds: Massese and Comisana. The management is in semi-extensive system by loose housing and a daily grazing time depending on the season.

Grazing, especially on *Hedysarum coronarium* and *Trifolium incarnatum*, is managed through a rotational scheme.

The innovation on grassland management is coupled with an optimal interaction with grazing toward an optimal milk yields production, obtained also selecting animals for their ability also to exploit efficiently the pastures.

The genetic selection is achieved measuring both the daily animal performances in grazing and stable conditions standardized by the quality of forage/pastures. In this way grassland production is deeply related to genetic improvement since animals are selected for grazing efficiency and for the efficient conversion of fodder in milk quality.

Recording flock performances and forage analysis, also the grazing management year by year can be optimized, for example calibrating number of heads per paddock, the rest period, pasture areas etc.

Animal recorded traits are: daily milk kg, protein%, fat%, casein%, *k*-casein%, somatic cells, lactose%, unsaturated fatty acids, MUFA, PUFA. Even other parameters as BHB and urea are measured.

The animal performances are elaborated together with forage composition to understand relation between grazing time and increase of milk quality, and between milk quality and type of forage/grazing used.

Not less important is the forage composition that must be optimal to allow the animals to show their "performances value". Thanks to the innovation in temporary grassland management, since 5 years the biomass composition is fairly constant, with a protein content of 14,5-15,5% for *Hedysarum coronarium* and 18-19% for *Trifolium incarnatum*.

Results

Through this innovative management criteria, the animals with higher ability to exploit grassland to increase the quality of the farm milk are selected. Genetic selection for milk production includes the adaptability of animals to semi-extensive rearing system, and this attitude has a sufficient hereditability to be transmitted to the population.

Top genetic rams and ewes are also sold generating a complementary income.

Year	Young Females	EWES	Lamb	Rams	Total female	Total Male	Total
2012	108	264	45	51	**372**	**96**	**468**
2013	121	332	47	50	**453**	**97**	**550**
2014	93	288	35	104	**381**	**139**	**520**
2015	118	286	50	68	**404**	**118**	**522**
2016	127	384	78	108	**511**	**186**	**697**
2017	201	324	85	142	**525**	**227**	**752**

Tab.1 Number of selling (heads)

Practical results show that selected nucleus use grazing more efficiently, positively influencing the quality of milk, particularly in the protein content and the profile of unsaturated fatty acids. Thus, the described innovation not only leads to the improvement of grassland management and environmental sustainability, but also directly increase milk yields and quality.

Adoption criteria

To achieve an adequate level of the genetic progress in medium-term investment is required ensuring the support of specific expertise. Asciano farm has in fact an agronomist advisor expert in Mediterranean grassland management as well as a geneticist.

Future prospects

These criteria of innovation can be adopted by any farmer willing to invest in genetics, grassland management and farm specialization, namely to record animal performances and sow the grasses/legumes that best suit the farm soil.

From grassland management to local cheese production

Farm: **"Il Forletto farm"**
Location**: Murazzano (CN), ITALY**

Background

The mountain area of Alta Langa (Piedmont region) is historically known as production and trade center of several typical sheep cheeses. Farmers located in this area, traditionally manage flocks according to the availability of grassland's biomass over the year, supported by seldom purchases of forage to face shortage in winter season.

The economic model is based on a family-run business that has stood out for its innovative approach to grassland management and the related production of the farm's cheeses.

Aim of this farm is to improve quality of the cheese produced, in term of fatty acids, vitamins, terpenes and taste, also through an innovative and economically sustainable exploitation of the grassland. The innovative approach has been also the strict monitoring of the color of cheese, heavily affected by the grazing composition.

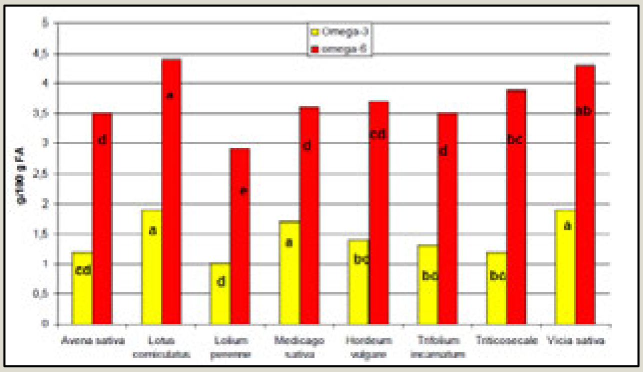
During the interview, the farmer said: "to improve cheese quality it is necessary to improve the milk either in the proteins and fatty acid contents and its technological properties, thus it is necessary to focus on grassland and also on flock".

Sheep cheeses from Langhe are produced with milk from Delle Langhe sheep exclusively. To protect the label, promote the products and improve the genetic values of the flock, Il Forletto farm adhere both to Delle Langhe sheep Producers Association and to Assonapa (National Sheep and Goat breeder Association).

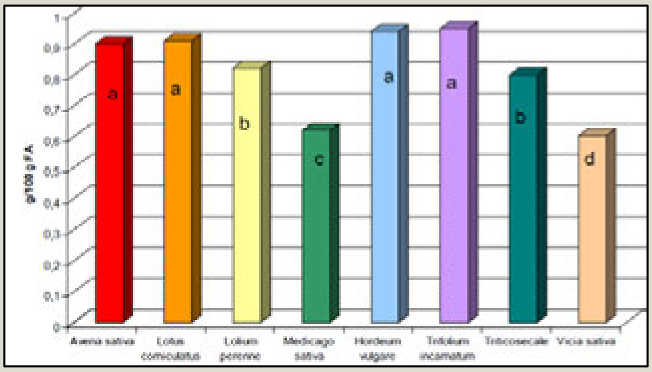
Detailed description

The innovation of Il Forletto farm is related to the ability to manage in a sustainable and innovative way the grazing and rearing systems, conserving the traditional features of the area and of the products. Il Forletto farm has treasured and embedded in the management many researches results on the influence of grazing in Piedmont mountain on cheeses characteristics and flavor. Some surveys highlight the relation between bromatological aspect of grazing and fat content in milk and the potential to influence milk quality through grazing management. Milk fatty acids profile is positively influenced by the high amount of PUFA content in herbs. Based on this, the strategy has been to increase the land with permanent grassland and to maintain natural grassland (rangeland) with a sustainable grazing rotation.

With the support of a senior agricultural advisor, permanent grassland surface has been sown with two mixtures of grass-legume considering their productivity and attitude to improve milk quality.



Omega-6 and Omega-3 content in milk with different grazing herbs



CLA content in milk with different grazing herbs (source: CREA)

Grassland (grazing and hay production) is managed following both biomass volume and optimal phenological phase (feeding value). During spring, most of temporary and permanent grasslands are destined to hay production (1 or 2 cuts), taking care to cut alfalfa with 10-20% flowering and managing grass at early growing stage.

After the first milking, the entire flock is left grazing in a paddock of about 13 ha managed according to the optimal livestock units per area and depending on the climate and temperature. During warmer periods, flock return to the stable after some hours otherwise it returns directly for

second milking at 5pm. To have a monitoring of overall flock health, feeding management and milk quality, animals are regularly subjected to performance recording and milk lab analysis.

Peak of biomass production in temporary grassland coincide with the firsts phase of lactation stage, therefore it is possible feeding dairy sheep in stable, mainly with green fodder cutted daily.

Il Forletto farm management respect the natural life cycle of the flock. During winter season, with low grassland production, ewes are in dry period thus the diet are mainly based on hay.

Thanks to this synergy between grassland and livestock management, concentrates are not necessary with a positive benefit also on the farm economic sustainability.

Results

Positive results on milk quality, monitored monthly by accurate lab-analysis. The optimal grassland management leads to an increase of fatty acids content of milk and to a constant milk yield over the lactation stages. Grazing and feeding systems permitted to reduce the costs of management and feed, saving resources and making the entire process sustainable.

After two year since the adoption of the management criteria described, it is possible to appreciate the benefit on the farm cheeses quality. Aromatic and terpenic contents have been increased and the milk quality allowed to enlarge the portfolio of cheese produced.

Adoption criteria

Il Forletto farm management comes from the idea to join scientific results, innovation and tradition towards a better product quality. Such a results have been made possible exploiting different professional skills. From the marketing and commercial perspective, stress the link between the geographic area and the local products is fundamental.

Future prospects

Future aims will be: enlarge the lab analysis of cheese quality including omega3, omega6 and CLA profile; further promote farm products; obtain a Certification (i.e. Organic Production).

Particular care will be devoted to temporary and semi-permanent grassland renewal avoiding soil fatigue with a focused fields rotation.

From grassland management and genetics to beef production

Farm: **"Nocentini Società Agricola"**
Location: **Dicomano (FI), ITALY**

Background

The rangeland of Mugello is located around the province of Firenze, in Tuscany, area particularly vocated to the production of high quality beef from special breeds as Chianina, Romagnola, Limousine and Marchigiana. Meat has always had a long-standing tradition in Mugello, and for numerous years, the territory has been dedicated to promoting this wealth.

Only breeds, which are able to adapt to the environment, are bred here. There are two different types of breeding farms, the organic farm, which abides by strict regulations, and the conventional one. However, all the feed is strictly vegetable and the living conditions of the animals are excellent. Pure bred calves are regularly slaughtered before they are 24 months of age.

Breeds are managed in semi extensive systems with large use of natural pasture, only seldomly supplemented by forage and concentrate.

The extensive system is already used in some areas of Italy for rearing sheep and cattle. The returns on capital and labour can be increased by making use of land, which is otherwise unproductive, often due to the climate or the nature of the soil. The expansion of this farming system does however require new production techniques involving structural and functional change which include: use of capital, fodder and irrigation supplies, availability of and management of the land and rearing methods.

Added to this there is a shortage of suitable land where extensive forage can be produced at acceptable costs and the problems of the land tenure system. Therefore, it is clear that there are a number of difficulties to be overcome if an extensive system is used to rear cattle and sheep in an efficient and cost effective way.

Nevertheless, there have been changes in the productive system over the last few years. There is public concern about the impact of agriculture on the environment, in terms of maintaining or increasing biodiversity, on landscape value and recreational use of land, on pollution and water quality and on animal welfare. This provides a glimpse of the possibilities offered by a different approach towards the use of productive resources, which can lead to an increase in the economic efficiency linked with forms of territorial integration and social and economic development.

Detailed description

Nocentini Agricola farm has been founded in 1980. Nowadays in farm are employed 4 people full time plus the two owners. The farm is totally focused on high quality limousine beef production by the cow-calf system. The farm extension cover about 270 ha among which, 170 ha as permanent grassland and 100 ha as arable land. On average, the herd consist of 180 adult cows and 6 to 8 bulls. The farm is managed on a semi extensive system with a UAA around 1.8 head/ha.

The innovation of SS Agricola farm is related to whole production chain, and in particular based on fattening of young animals immediately after weaning, on a grazing before weaning, instead of cultivated grassland grazing with no adverse consequences for the performance of the young cattle. The extended use of grassland produces animals which are appreciated on the market, and provides other amenities in terms of animal welfare, environment, healthiness and safety of the meat.

SS Agricola has pure Italian Limousine. This breed of cow finds its origins in the Massif Central in France, and has expanded notably throughout the Mugello area where give origin to the Italian Limousine Nucleus.

It has always been bred for its meat, but a careful selection process has made it a highly specific breed that provides a great deal of beef at the time of butchering and calves that can be sold any time from 3 months to 2 years of age. The gregarious nature of the animal and the robustness of its legs and thighs result in excellent Limousine herds that graze prolifically. The cows calve easily, and this can take place sometimes more than once a year. The maternal instinct of the cows, the quantity of milk produced and the fact that it is rich in fat guarantee the calves a healthy growth rate, which takes them from their rather low birth weight, less than 40 kg, to over 250 kg at the time of weaning at 6-7 months of age.

Other characteristics, which are a result of the selection process, are long life span and fertility.

The Limousine cow, both older and younger animals, has a reddish-brown hide with lighter patches around the eyes and snout.

Results

The perfect match between tradition and innovation, coupled with an optimal use of the genetics and breeding made the Nocentini farm among the top ten beef farm in the region. Particular attention is paid to the correct management of the grassland to keep the entire production process above the standard in quality and maintain the timeline sustainable.

The optimal grassland and arable land management allows the farm to self-produce more than the 90% of the total feed required.

After a gestation (pregnancy) of nine months, the cow (mature female) will usually give birth to one calf that weighs around 30 to 45 kg. Critical cows are seldomly kept in calving areas during the calving period, so that farmers can keep a close watch over cows and calves during this critical period. Cows will remain active in the breeding herd for more than 8 years.

The calves are weaned at six to seven months of age, and at a weight of about 250 kg. For the next stage of the beef production cycle, the beef animal will typically be brought to a finished market weight of approximately 550 to 700 kg.

The farm produce more than 180 calves per years with an average carcass evaluation steadily above R+ and reaching very often E or S of the SEUROP classification score.

Adoption criteria

Nocentini farm is an example of perfect match of innovation and tradition. The management routine of the grassland has been set benefitting from the connection with University and researchers and is constantly updated based on the more recent research results.

The total biomass as well as the species richness and the edible value of the pasture are constantly monitored to balance the animal load per ha and assure that every cow has a sufficient availability of forage and energy.

Each calf is also weighed on regular basis to monitor the daily gain and also produce data for the genetic evaluation. The farm in fact is associated to the ANACLI breeder association in charge to manage the Italian Limousine herd-book (all the animals of ss. Agricola are subscribed in the herd-book) and participate to the Italian Limousine breeding program.

Future prospects

In the future the farm envisage to enlarge the herd of course compatibly to the land and grassland available, and adopt a genomic evaluation methods to improve the genetic make-up of the cows and bulls.

Also a specific plan to monitor the environmental impact of the production, the SAI platform approach, is under evaluation to be adopted and, possible underwent to a certification of " environmentally free production".

« Marguerite Happy Cow »
Differenciated milk cooperative

Farm: **Ferme du Bois de Herve – Christophe Darchambeau**

Location: **Herve (Belgium)**

Background

The farm is located in Herve, a small city near Liège in the Eastern part of Belgium. The village gives his name to all the agricultural region called "Plateau de Herve", which is a permanent pasture region. More than 90 % of the agricultural area is covered with permanent grassland and the region is specialized in cow milk production. A special cheese is also called "Fromage de Herve" and is protected by the European IGP system.

Christophe Darchambeau's farm is a typical farm of the Plateau de Herve. It's operating on 60 ha, mostly occupied by permanent grassland and 7 ha of maize silage. The farm counts about 80 dairy cows and 60 young females for replacement, all Holstein breed. 40 ha are close to the farm and provide the necessary surface for a pasture based production during around 7,5 month a year.

In 2008, when he was 25, Christophe settled as a dairy farmer. He took over the farm of his uncle. During the first years, his wife continue to work as an employee, but they have the ambition to work together on the farm.

With the dairy crisis of 2014, Christophe and Sabine are faced with two options: either they borrow and heavily indebted to increase their herd of cows, hoping to reach a decent income; or they diversify their activities in order to increase the earning.

The couple then decides to start a few school visits. Then they invest themselves to receive and animate the proposed activities. Today, the couple works full time on the farm and has just hired a person for the summer season. It’s very important to present agriculture to other persons and especially children. The farm welcomes more than 3000 persons a year with this activity.

Detailed description

The innovation concerning grass is the participation of Christophe Darchambeau as member of “Marguerite Happy Cow”.

The cooperative Marguerite Happy Cow existing since 2015 and brings together regional dairy farmers and processors. In 2017, 9 dairy farmers are involved for a production of about 4 million liters milk per year, one feed processor and 2 cheese factories. The aim of the co-op is to product a differentiated-quality milk, based on grass and local production. Another goal is to give the concerned producers a fair income for this quality. From now on, consumers are also allowed to take part into the co-op.

Production specifications are discussed between cooperative members and are controlled by an external certification organisation. Here are the 5 key specifications for Marguerite Happy Cow :

Grass and pasture :

The first and most important point is linked to grass, which is very important for the quality of the milk and the quality of the cheese.

Milking cows must pasture at least 180 day per year. The surface rate is maximum 4 milking cows per hectare of pasture, in average, during all the season. The total ration (raw forages) must also include more than 70 % of grass.

Local feed :

All the feed must be natural and local.

All forages must come from less than 100 km ; and all concentrates from less than 300 km. Anyway these restrictions about pasture and grass (here presented and other) lead to reduce forage importation needs. GMOs and palm products are also strictly banned.

A differentiated-quality milk :

Grass silage must be analysed and must be dry enough. The milk quality is controlled every time and has to respond to high quality criteria. These are about maximum presence of butyric and e.coli. The minimum protein content must be 3,4 % in average on the year. The milk is loaded distinctly and goes directly to the cheese factories.

Human scale and fair income :

The obligation to pasture enables to keep human scale farms.

The milk price is always higher than other dairy. This is justified by the high quality of the milk and the farmers production constraints. The bonus varies, and depends of the average milk price in Belgium. When the milk price is low, the bonus is higher. This contributes to give dairy farmers a fair and more stable income.

Local products :

The local transformation into cheeses, and also other products in a near future, leads to generate added value for all members of the co-op. Members are more implicated in all the process and can benefit from this more efficient integrated production system.

Results

An adaptation phase took place. During one year, before the engagement in the cooperative, the milk quality and the implementation of the other specific production requirements were observed on the farm.

Some requirements needed for the production of cheese imposed small changes. It's more adjustments than big transformations. And these adjustments don't need investments or costs. For example, the silage dry matter has been changed. The silage is now harvested at a higher dry matter for the quality of cheese. Also, cleaning wipes are now used for each milking.

The milk price is more stable in the Co-op. But this result is less visible during the last two years, because the standard milk price is quite stable and high.

There is a good satisfaction to produce a differentiated-quality milk. The communication with consumers is also very important and completely in touch with the other activity of school visits.

Adoption criteria

The first important criteria for Christophe is economic. The participation into the Co-op don't need financial investment or major modification in his farm. It's very important for a young couple of farmers.

It allows to participate to local production (very popular nowadays) with no needs of big investments or additional work on the farm.

Another important criteria is communication. For the participation in this king of project, farmers must like to communicate, with other farmers and processors in the cooperative and with consumers. It’s also important to respect also the decisions of the Co-op and to implement modifications if needed.

Future prospects

Since 2018, the co-op is also open for the consumers. They can invest small amount, but the goal of this is not the money. With the inclusion of consumers the co-op can have a feedback and fresh ideas about the products,… and it’s a beautiful way to make publicity by word-of-mouth.

Barn drying

Farm: **Birkenhof / Lentz Rainer and Evelyne**
Location: **Amel (Belgium)**

Background

The farm is located in Schoppen, a section of the town of Amel in the Eastern part of Belgium. Rainer took over from his father in 1997 and since 2014 he transited to a 100% organic milk production.
Today the farm is composed of 116 ha with with 132 Fleckvieh milking cows. He is working on the farm with his wife and a paid worker. In 2002, a new cowshed (wood construction) was built for 100 cows and the old cowshed from 1978 converted into a shed for Heifers. During construction, they have put emphasis on a cost-effective solution and the highest possible comfort for the animals. The milking parlor dating back to 1978 is used for milking the 132 Fleckvieh cows.

In 2002, they also started the breeding of Fleckvieh. The first years they bought a Fleckvieh bull, while continuing to use holsteinsemen in artificial insemination. After the first consistently positive results, they started in 2005 to switch the herd completely to Fleckvieh. Reason was then, on the one hand, the lack of alternative to the extreme breeding (fragility of the Holstein) and on the other hand, the bad calf revenues of the Holstein breed. In search of a dual-use breed, which combines high milk production with a strong and healthy animal, they found the Fleckvieh breed.
Since 2012, they put an increasing importance to seasonal calving. Since 2015, most animals calve from October to April. This is so in order to optimize the grazing (short grass grazing pasture), to organize the working hours better and to leave the calf stable empty for a few months.
The reflections of the farmers to become more efficient, more productive, to lower costs, to lower the workload and to better the quality of the end-product led them to these decisions. The desire to lower the feeding of concentrates, to better the animal health, to produce an end-product with added value that stand out and that is highly desirable by the consumer led them to explore the barn drying system.

Detailed description

In 2017 the farmers have equipped the farm with a barn hay drying system. This installation is working with a condenser, which aim is to dry the air. This is done by cooling it down under the condensation point and warming it up again afterwards. The barn that was built is 60 m long, 22 m wide and is divided in 4 different compartments, each one 1400 m³ big.

The barn hay drying enables to loose less matter on the field and to produce an enhanced hay quality in opposition to hay dried on the field.
In principle, the grass is harvested after a first on field drying. This grass is, then, transported to the on farm drying barn, where it is dried and stored. The drying is done through a hot and/or dry air ventilation through the mass of grass.

Mastering barn hay drying requires some expertise. The first step is to harvest the grass at a minimum of 55-65% DM. In our region, it takes 2 to 3 days on the field, in favorable conditions. This system, based on multiple harvests of smaller volume allows more flexibility. Cutting over time also allows staggered regrowth and facilitates grazing management.
Requiring even more expertise and know how is the management of the drying in the barn. The grass has to dry fast enough and in a homogeneous way, but at the same time with low energy consumption. In addition to the 2 days on the field, it takes on average about five more days of drying in the barn. The hay milk allows a simplified very efficient grass-based forage system with a greater autonomy. It reduces harvesting contractor costs, traction and machinery equipment.
There is little data on the economic impact of this technique. Depending on the type of installation and its size, the investment can vary from 200 000 to 1000 000 €. In this particular case, the installation has an investment cost of around 750 000€. On a 20 year basis, with an annual milk production of about 800 000L, this makes around 5 cent/liter of investment costs

Results

The farmer has an efficient management of his forage area. The cost price of the grasslands is only 440 €/ha. This low figure is possible due to the low cost of the equipment.
Herd fertility is also excellent (age at first calving 28.9 months, calving intervals: 390 days). The average production per cow is 6200 liters with 4.14% fat and 3.48% protein. The majority of milk is produced through roughage. In 2017, each cow received an average of 750kg of concentrate, compared to 1000kg/cow in 2016. This concentrate is almost exclusively fed during the winter. In summer there is no need for concentrate thanks to the short grass grazing.
The average lifetime of the cows on the farm is 6,5 years with an average of calving per cow of 4.
Unfortunately, the impact of the barn drying is not yet to be seen fully. Ideally, we would have to look at the numbers in one or two years.

Adoption criteria

To implement this type of innovation it is needed to build the infrastructure and to get it running properly. Secondly, you have to learn the necessary know-how to get a perfect end product. These 2 points are the most difficult regarding the implementation of the innovation

This drying method has many advantages:

- Reduced forage losses in the field (in comparison to classic hay)
- Better nutritional quality of the grass
- Improvement of palatability and ingestion
- Better forage quality that improves animal health and increases production; or at equivalent production, reduces concentrate consumption
- A milk quality that is ideal for cheese production.

The main criticism of this kind of installation is the very high cost of the initial investment.
Moreover this mode of harvest and drying management, which is more technical and more laborious than silage, is not suitable for everyone.
The main recommendations for any farmer interested in this method of drying are:

- Pay particular attention to the design of the installation
- Consider less expensive barn drying systems
- Acquire know-how for the management of the dryer
- Put in place a better valuation of the final product of the exploitation (milk, meat,…)
- Consider the overall direction of the farm in order to maximize the benefits of this method. For example, barn drying is very well adapted to organic production and cheese production.

Future prospects

Aim of the barn hay drying is to produce the same amount of milk with 50% less concentrates (500kg instead of 1,000kg/cow). The farmers expect to achieve at least 5000 liters through roughage feed, increase the longevity of the lactating herd, reduce veterinarian costs by 30% as well as the workload. In addition to that, it is also intended to get 5 cents more per liter milk from cheese production factories. For the moment, the milk is marketed by the Biomilk dairy, currently without any specific added value.

Short-grass grazing

Farm: **Theissen Bio-Farm**
Location: **Büllingen (Belgium)**

Background

The farm is located in Manderfeld, a section of the town of Büllingen in the Eastern part of Belgium. The father “René” took over from his father in 1979. The same year he build a new stable for the milking cows. In 1998-2000, he transited to a 100% organic milk production. In 2009, his two daughters integrated the farm. The same year, they started to interest themselves to short-grass grazing. In 2010, they build new stables to enlarge the farm and they acquired an additional 50ha.
In 2009, the farm was composed of a total of 53ha and 50 red-Hostein milkin cows.
Today, the farm has about 100 dairy cows. It includes mainly Brown-Swiss, Jersey and Montbéliard breeds. However, since the farm was originally a red and black Holstein farm, there are still some Holstein crossbreed in the herd. They are operating on 112 ha of grassland, of which 30 ha are from high biological value. 40 ha are in direct proximity of the farm and thus, provide the necessary surface for a pasture based production.
The constant reflection of the farmers to become more productive, to lower costs and to better the quality of the end-product led them to turn towards the short grass-grazing pasture management system.

Detailed description

It’s been 9 years that the farm practices short grass grazing, a technique which aims to keep the grass short (about 6-7 cm high) throughout the growing season. The size of the available grazing surface is continuously adjusted so that the daily consumption of the cows equals the growth of the grass in the meadow.

Usually the cattle are released in the meadow for the first time mid-March. At this period of time in the year the cattle still get a complementation of fodder in the stable, but it’s very important to keep the grass very short from the beginning of the season. Then, from mid-April to mid-May, 25 to 30 acres per cow are sufficient, without additional complementation in the stables. From the beginning of May, the growth speed of the grass reaches its peak. The pasture is then mown, removing a certain proportion of the surface. After mowing, additional surface is made available for pasture to compensate for the slower growth rate of the grass in the summer. The 40 hectares of pasture are divided into two plots, one for the day and one for the night. This is so for the convenience of the farmer.

The grass adapts itself to the pasture conditions. The grass becomes denser, and leaves little room for the development of weeds. Rumex, for example, can not bear to be grazed repeatedly and dies out. On the other hand, these conditions ensure the growth of English rye grass and white clover which benefits from additional light and enriches the pasture with nitrogen.

Thus, short grass grazing provides very digestible protein-rich grass. The low height of the grass imposes intensive grazing, increasing the salivation, which prevents acidosis problems.

To optimize even further the use of the pasture, the Theissen family chose to organize the calving of seasonally. The cows calve between January and the end of April, thus enabling the cows to have the best grass at the peak of their lactation.

All the organic milk of the Theissen farm is sold to the dairy factory Arla.

Results

The average organic dairy yield of the Theissen farm is around 5,400 liters (2017) of milk per cow and per lactation. Theissen's dairy cows receive only 350 kg of concentrates per cow per year, just enough to encourage them to return at the stable for milking. As a comparison, organic milk farms in the area produce on average less then 6000 liters of milk with 900 kg of concentrates and conventional farms produce on average 7,000 liters of milk with 1,800 kg of concentrates per cow. The average lifetime of the cows on the farm is 6,5 years and they have in general an average of 4 calves before they leave the farm.
For the farmers, this grazing management system enables them: more autonomy, more efficiency,

to reduce costs, to work less, to create a better quality of milk and to get a better revenue.

Adoption criteria

First, the most important condition for short grass grazing is to have enough available grazing surfaces around the farm. It should be possible to make 2 big plots with at least 0.15 ha per cow each. There is not really a need for over sawing the pasture. The vegetation adapts itself to this grazing type. There is not much to do besides adjusting the size of the pasture to the growth rate of the grass.
The breeding of the herd towards a more adapted breed to grazing as well as the seasonal calving are both options that enhance even more the productivity of the grassland.
If the technique of continuous short grass grazing is not applicable to all farms, it can nevertheless lead to a reflection on the optimal valorization of the grass, which is an ideal food in terms of nutritional quality and economy for the farm.

Future prospects

The future prospects of the Theissen dairy farm are bright.
However, for the future prospects of the short-grass grazing pasture management as a whole, one thing they would hope for is to see more independent scientific studies to be made on the topic. There are already many studies around the subject. Unfortunately, most of these are conducted by enterprises that have a commercial goal. Therefore, the result of these studies are not unbiased.

Techno-grazing all year round

Farm: **"Ferme expérimentale du CIIRPO"**
Location: **Haute-Vienne FRANCE**

Farm description

> 1.5 annual work unit

> Sheep breeding

> 115 LU with 720 ewes of Romane breed, Vendéenne breed and F1 crossing

> 95 ha with 90 ha of forage crops : 43 ha of permanent grassland and 47 ha of temporary grassland

> Soil type: loamy-sand

> Production: slaughter of 4 months-old lambs, 18.5 kg of carcass weight on average and average ranking R3

Climate

Temperate oceanic climate with fairly severe winters in the area and in recent years many summer droughts.

Background

The "CIIRPO" (Inter-Regional Center for Information and Research in Ovine Production) is currently carrying out a test on cell grazing.

The aim is to develop as much grazing as possible in the system by restricting forage crops thanks to cell grazing. It reduces costs by improving grazing, reducing harvests and reducing investments in equipment / buildings.

The objective here is to compare the management of the herd between cell grazing and traditional rotational grazing on different aspects: time, costs, grass growth, parasitism... Thus a batch of ewes is managed with traditional rotational grazing (5- 6 days paddock) and another batch with cell grazing.

Detailed description

Cell grazing is defined as: "Developing a system based on maximum grazing by limiting forage crops through cell grazing".

Since September 2016, ewes graze 1 to 2 days per cell depending on the grass growth. The size and number of cells are also adapted depending on the grass growth and the instantaneous stocking rate.

The animals return to the cell 21 days later in spring until 35 days in summer / winter.

The instantaneous stocking rate is 150 to 600 ewes on 1 ha depending on the season.

The ewes graze all year round.

Results

With this grazing technique, all grass have been used, it was not needed to grind any leftovers.

However, there are also fewer crops available for fodder.

The daily work is greatly reduced in winter thanks to the winter grazing but the technique includes much work for setting up the fences.

The technique has allowed them to gain in concentrates and to maintain the performances of the animals.

Adoption criteria

This technique works at CIIRPO because the farmers are rigorous. It requires a minimum technical supervision at the beginning of the practice.

The farmers need to be equipped for watering and for distribution if they want to give concentrates while grazing and to have parcels close enough to one another.

Future prospects

Cell grazing is a good technique but it requires rigor and precision.

Currently the biggest threat for this innovation but also for grass farming in general is drought. Indeed, adapting grasslands to climatic conditions will be a great stake for the future.

It is necessary to look for ways to adapt grasslands to the lack of summer water if we want to continue to value and promote "all grass" systems.

In addition most grassland and therefore the cells plots do not have shadows, so it is necessary to put great attention in animal welfare.

Moreover, lambing period is critical when ewes are grazing all year because of predation risks.

Eco pastoralism on the edge of the Loire

Farm: **"Didier Crèche"**
Location: **Loir-et-Cher FRANCE**

Farm description

> 1 annual work unit

> Sheep breeding

> 220 ewes

>142ha totally of grass of which 100 of eco pastoralism

> Objective of productivity: 1 lamb/ewe

Climate

Climate is continental with cold winter and warm summer. Climatology and soils are not conducive to good grass growth throughout the year.

Background

In 1999, the CEN Centre was looking for sheep farmers to graze spaces in order to avoid mechanization in these areas and to preserve biodiversity. At the time, Didier Crèche is convinced and motivated by the approach and adheres from the start. For him it perfectly combined nature and agriculture as well as the conservation of spaces to see races for the Solognote which is very suitable for this type of pasture. He found the original concept and the idea of assuming a shepherd's post was interesting. Moreover, the pioneering side in a non-mountainous region pleased him.

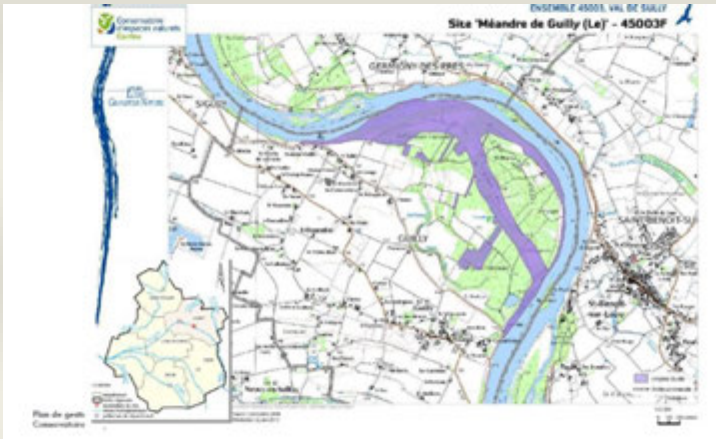
The evolution of the gait then led them to the banks of the Loire with the Pasto'Loire project. The expanses bordering the Loire naturally tend to become wooded since the second half of the 20th century. Grasslands and lawns are "closed", gradually invaded by shrubs and bushes. The planting of this shrubby vegetation is to the detriment of plant and animal species that prefer the light and heat conditions offered by so-called "open" environments.

In addition to the biological diversity they harbor, these areas have other interests in relation to the functionality of the watercourse: they act as expansion fields for the river, contributing to the purification of water and maintaining its quality, but also limiting the impact of floods downstream.

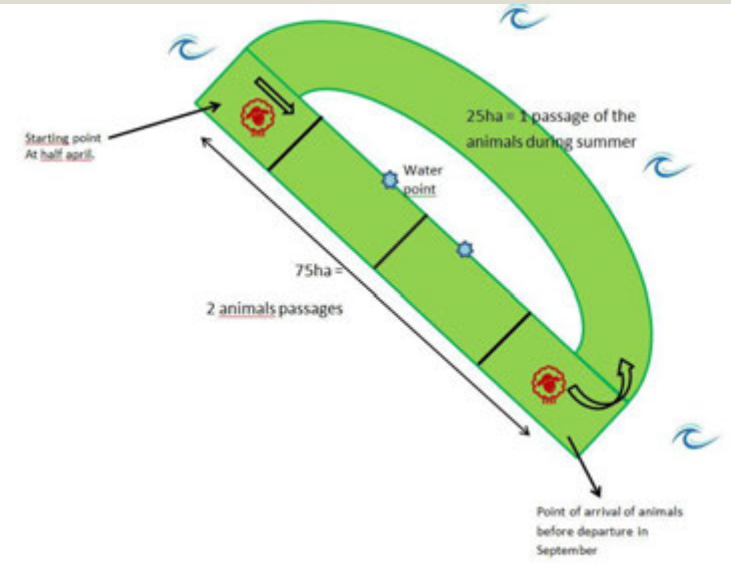
Detailed description

Didier Crèche is today a farmer grazing on the edge of the *Loire* in Loiret. His flock grazing 100ha and intervenes today on the Méandre de Guilly

Site Map



Under reciprocal contract for a period of 5 years with *CEN41* the ewes value and reopen spaces in the Loire, grasslands and promote biodiversity. The Solognote breed is very suitable for this type of pasture and the breeder is also very involved in the selection of the breed almost extinct a few years ago.



The total area of 100ha is divided into 5 plots. The grazing season starts around April 15th after the kicks and hard until early September.The part situated at the edge of the river is pasture in full summer because it is the least drying and shaded part for the animals which at the same time have a water point assured.

The breeder is located far from the site; he has on the spot of a foot to earth (caravan) to optimize his time and its displacements.

On the spot he carries out work of fences and movements of herds helped by 2 dogs of herds.

Results

The result obtained here is mostly ecological and environmental and not financial or productivist. The goal of the project and the breeder by participating is not to improve its production but to reopen landscapes with animals and brought back forage varieties, insects ...

For the farmer, it is the way to make the link between nature and agriculture and it is a satisfaction to see its animals at the service of biodiversity.

However, in return for the time, the commitment, the costs ... the farmer has to touch the MAE up to about 20.000 € / year, unfortunately he is still not affected at the moment.

Adoption criteria

Innovation can only be adopted if there is financial compensation for the breeder of any kind. Indeed the human and material investment requires that it is compensated otherwise it is not viable.

The distance is also a brake, the farmer currently has 1h30 drive between his place of exploitation and the grazing site, this is very important and it would be easier for someone closer to intervene quickly and lose also less time during trips.

Future prospects

The farmer is practically reaching retirement age but unfortunately does not want his farm to be taken over by a young person because he has not yet touched his EAW, he does not want to put a young person in danger with conditions of departure too precarious. He is doing well because he has a stable situation, posed and is at the end of his career but a young person who has investments to amortize this would be impossible.

One of the main threats to this type of project is therefore the financial aspect and the compensation for farmers

The project is a more ecological and environmental level for society so it must be better valued financially. We sometimes favor other cultural actions ... but projects like this one are poorly supported.

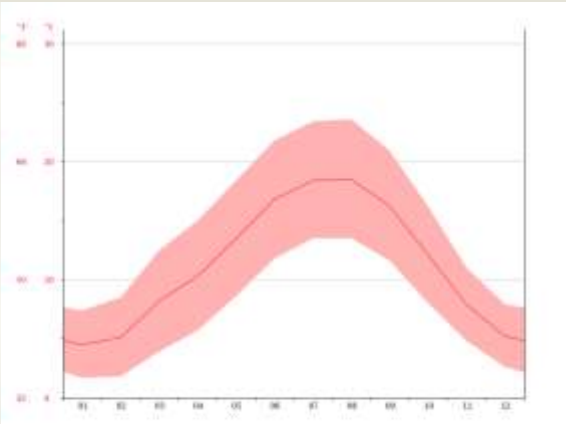
In addition, another threat to this type of innovation is that the conservatories and other organizations at the head of this kind of projects do not add too much constraints for the breeders in terms of fences, treatments, management of spaces ... Otherwise, it will be difficult to keep economic profitability, animal production and working time coinciding with the environmental side.

A sustainable and high performing system on a living soil

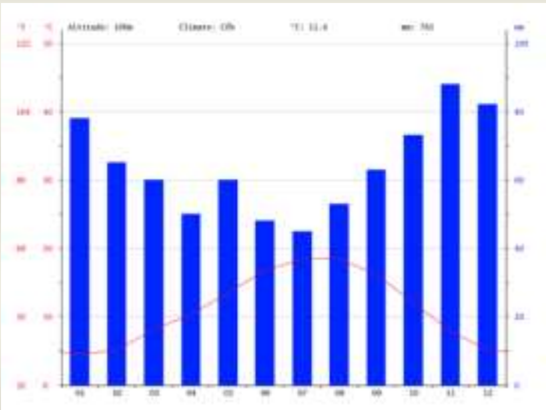
Farm: **"EARL Barreau"**
Location: **Vendée FRANCE**

Background

The farm is located in Saint-Aubin-des-Ormeaux in the east of the department of Vendee belonging to the region "Pays de la Loire" in France. This municipality is located near the Sevre Nantaise river in a bocage landscape. The climate is oceanic. In a year, the average rainfall is 765 mm. The average altitude is 104 m, it varies from the low point of 52 m to a maximum at 141m.



Average of temperatures



average temperatures and rainfalls

The farm belongs to Frédéric BARREAU and his father since 1983. First, the farm area was 70 ha. They raised sheeps, poultry label and a breeder-fattener system holding comprises an average of 20 suckler cows. The farm has changed over the years. They have stopped the sheep farming and the number of suckling cows has gradually increased to reach today 64 cows and 2 poultry label buildings. The breeder-fattener system has been maintained. In 2008, they got a certificate confirming the registration of cattle herd in herd book Limousin. First, they grew a variety of crops including Italian Ryegrass, corn and wheat. The feeding of the herd is based on a grazing system since some years. Currently, 60 ha are multispecies grasslands and 10 ha are sown in triticale. The soil dries quickly because it is sandy and rests on shallow granite. Therefore, the soil is the most limiting factor for annual crops. The increase of the intensity and duration of drought, the fall in meat prices and the desire to preserve the soil are the reasons that led Mr BARREAU to drive his polyculture model to a grass-based breeding system.

Detailed description

The first step was to remove silage maize and increase the part of grass area. The farmer also adopted the direct seeding system in 2008. The grazing system has been linked to the conduct of the herd to maximize grass intake during demanding times of the animals. Therefore, the herd is driven to have as few animals as possible with important needs during the summer drought period. The calving season starts on august and 85% of calving are done on two months.

The farmer has implemented strip grazing. The pasture area is grazed by setting two moveable fences in front of and back to the animals. Fences are moved once per day. This grazing management allows a good spread of animal waste on and up to consume some of the standing hay to limit costs. The farm is equipped with an underground water network beneath the whole pasture area.

The reduction of loads is maximized about mecanization and inputs make a win about 2200€ per year.

This driving objective allows to take out surplus grass as quality silage or early hay for feed in winter. It allows to keep animal productivity by being economical. This mowed area is then reintroduced in its entirety for summer grazing with a bit of anticipation. All the lots of breed are managed in the same conditions and in this way the grazing season can be extend until September while the majority of farmers are feeding their animal sooner in July. The soil quality contributes at the growing process of the grass and the high cover during summer helps maintain soil moisture and keep soil alive.

Results

This system is sustainable because of the soil preservation. It is resilient because of low input consumption. The low level of mechanization decreases loads and the implement of strip grazing management have made inputs 2200 € per year lower. Farm is also competitive because of low labor need (disposal income of 2.3 SMIC (guaranteed minimum wage)/LU). The work on call in winter time is about 5 hours, and 2,5 hours during pasture season. An additional half hour is added in case of strong warm period to insure the good water intake for the animals.

Thanks to this management, the stocking rate has increased from 1,5 UGB to 2 UGB in a couple of years. It has also reduced the stock forage part in diet to 1,2 ton per UGB while the norm is 2 tons in this area. This system allows a grass yield up to 7,5 tons of dry matter per ha while the average potential is about 6 Tons in this area with usual conditions of rainfall and temperature. This economic system is not really dependent of the european Subsidies (100€ per Ha for a year by the historic reference).

illustration of the soil life: this pipe was drop 6 years ago on the floor

Adoption criteria

This innovation can be disseminated to other places by adapting it to the weather conditions. Keeping a suitable feed security part (to be defined according to the pedoclimatic potential) must be an objective to maintain resilience to climate hazards that become a major risk factor. Exchange and sharing remains an important value for reinsurance and avoiding pitfalls, as Mr Frédéric BARREAU did during the transition of his system (WEB, forum, exchange group, training, etc.). This is an important point that allows him to keep moving forward. Each new system need to find the good balance between grazing and stocks for be safe in case of dry period. That’s one actual risk.

Future prospects

In his farm management, with the increase of the stocking rate, Mr BARREAU Frédéric has highlighted some new points of fragility:

- The recurrent autumn drought which penalize grassland sowing and which leads to a return to patches of crops in order to better exploit the potentials (several mixed legume-cereal forage and cereals) and no longer return from meadows.
- The dependence on straw for bedding that could be overcome with the use of the farm wood.
- strengthening the quick fat feeding of unfit animals, to save fodder and thus potentially increase the herd of cows.

Cost reduction thanks to dynamic rotational grazing

Farm: **“Emilie Macé”**
Location: **Normandie FRANCE**

Background

<u>The farm</u>, located in the department of Eure, consists of:

- a herd of 350 sheep and lambs of the Texel breed
- an all-grass system with 47 ha of unfertilized natural grasslands
- 1.5 LU

<u>The environment</u> consists of:

- a good quality soil type
- a temperate oceanic climate marked in 2018 by a significant summer drought but suitable to grass harvesting in the spring

<u>With regard to grassland management</u>, the criteria are as follows:

- natural grasslands composed of multi-species mixtures, with 2 main types encountered: White Clover-Red Clover-Birdsfoot-Trefoil and Rye-grass-Brome grass-Fescue-Cocksfoot-Bluegrass-Creeping soft grass
- 100% of grasslands are grazed (73% of which are grazed and mowed)
- type of forage conservation: hay

Two batches of ewes (250 in total) are conducted in dynamic rotational grazing since spring 2017. The young ewes are conducted in rotational grazing with complementation.

The main reason for this choice of system is the desire to reduce food costs, thanks to quality grazing, and also to reduce the parasite pressure on the farm.

The technical mastery that innovation implies is one of the great sources of motivation of the breeder.

Innovation is also part of the search for a better use of grass by lambs.

Detailed description

Recent implementation of dynamic rotational grazing (in 2017) in sheepmeat system. The ewes are grazing all year round, they only return a few days in sheepfold for lambing.

The breeder has set up dynamic rotational grazing on the 2 main areas of the farm:

- Area 1: 13 ha divided into 13 plots for 100 ewes with twin lambs (1 day / plot)
- Area 2: 13,5 ha divided into 13 plots (7 plots in 2017) for 150 ewes with single and twin lambs (3 days / plot)

<u>1st batch of ewes on area 2:</u>

- lambing in February
- the lambs from this lot are kept for the renewal of the herd (100 / year)
- dynamic rotational grazing from March 1st to June 1st, 120 days
- 3 days / plot on average
- 1 month into the building
- Weaning on June 1st and then on grass (ewes and lambs separated) from June 8th to September 1st

<u>2nd batch of ewes on area 1:</u>

- lambing in March (April-May in 2017)
- butcher lambs
- dynamic rotational grazing from May 1st to July 15th, 75 days
- 1 day / plot on average
- 1 month ½ into the building
- Weaning on July 15th and then back on grass (ewes and lambs separated) from July 20th to September 1st

The lambing period of the 2nd batch of ewes was brought forward one month in 2018 to meet the objective of optimum use of grass by the lambs at the time of grazing.

Results

Dynamic rotational grazing reduces the parasite pressure on the farm and therefore the use of dewormers.

This grazing management allows to have homogeneous lambs with a satisfactory weaning weight.

This technique makes it possible to have a regular contact with the animals and thus to obtain a better follow-up thanks to a better anticipation.

The health status of the grasslands is also improved in terms of weed control such as common thistle.

In 2017, the technical and economic criteria did not improve compared to 2016, except for veterinary fees which decreased by € 2 per ewe. This finding is not related to the implementation of dynamic rotational grazing on the farm but to a poor reproduction period in November 2016. This has strongly impacted the prolificity of ewes and therefore the productivity of the herd. The prolificity rate has indeed decreased by 15% in 2017 compared to 2016. These criteria will probably improve during a normal year. That said, the year 2018 has not been one again!

Adoption criteria

The success of this innovation stems from the breeder's desire to improve the use of grass.

It implies having a good technical mastery in the grasslands management, especially in the organization and layout of the plot (size of paddocks, access roads, water points ...).

Advantage of having 2 big areas grouped together on the farm.

The breeder considers herself to be a breeder of sheep and a producer of grass.

Future prospects

The farmer would like to extend this innovation to all sheep on the farm. About 50 young ewes and 50 ewes are still on "classical" rotational grazing, for reasons of surveillance and nutritional supplementation. The goal would be for all animals to be led in dynamic rotational grazing.

Thus, it is necessary to rethink the organization and layout of plots that are not in DRG today, and perhaps even to review the size and the cut of the areas that are already there.

This requires an investment in working time and equipment (water points, etc.) to set it up.

This innovation can be disseminated by:

- grazing promotion events, such as "Prairiales" in Normandie
- specialized websites
- exchange forum

The threats or fears that can slow the development of this innovation are:

- the increase of herds which limits this technique when the herd is too large
- global warming and especially extreme periods: intense rains that can encourage the animals trampling or the periods of hot weather, such as this summer 2018, which can come to stop the restart of grass growth.

Doubling grass loading with rotating grazing and grassland renovation

Farm: **"François de Chénerilles"**
Location: **Indre-et-Loire FRANCE**

Farm description

> 1 annual work unit

> Sheep breeding

> 600 ewes

> 138ha of which 127ha of grass.

> Objective of productivity: 1.4 lamb/ewe

> One main soil type: Clay

Climate

Climate is continental with cold winter and warm summer. Climatology and soils are not conducive to good grass growth throughout the year.

Background

The farmer had unproductive meadows in quantity and quality and could not increase livestock or improve his food costs with the current system. Regional actions are set up to support the change around fodder autonomy so he has to take advantage to review his system. He had the will to produce grass for the herd with the possibility of fattening some animals on grass, to exploit the potential of his lands which are not so much grain lands. He wanted to find a profitable and productive sheep farming.

Detailed description

The farmer has set up the rotating pasture on his farm and at the same time reinvents his permanent meadows thus enabling him to double his herd (300 to 600 ewes).
Renovation of grasslands from permanent grassland to temporary grassland benefits biodiversity provides more forage resources for use and can have a good impact on animal health (reduction of parasitism).

Indeed, it uses a multi-species mixture with forage colza at sowing. Thanks to this, he can graze after two months.

It also uses tannin plants such as chicory and plantain that have a positive effect on grass ingestion. The second advantage of these plants is their pivoting root system which allows better moisture retention during the summer.

Finally, the management of the minimum and maximum grass height on pasture was set up and has allowed to reduce the plots size and foster grass growth.

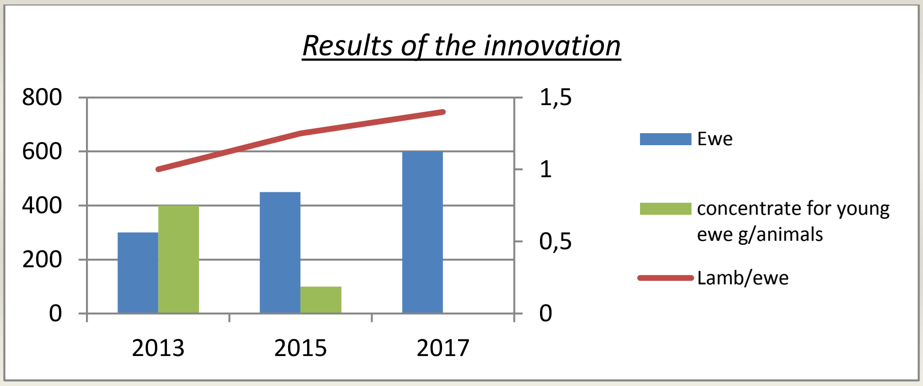
Thanks to this, he doubled the herd from 300 to 600 ewes on the same surface, the ewes now graze all year whereas before it was only 6 months. Before slaughter, he is fattening the reforms on grass as well as for some of the lambs. Young ewes do not receive concentrate anymore (before 400 g / lamb).

Results

The workload has been significantly reduced. The ewes being more time on pasture limits the constraint work in the building: mulching, feeding, etc. to the birth period only.

Profitability was also improved from the very first year, the farmer invested about 6000 € to renovate his grasslands and had an economy of about 14.000 € (+ 8000 €). Savings happen thanks to the significant drop in inputs: feed for fattening or for ewe lambs, preparation for lactations partly on grass...

Production has also increased: prolificacy and numerical productivity has improved from 1 lamb sold per ewe to an average of 1.3 now.



For the farmer's point of view, the result is not only economic, the setup of this system also allowed him to question again, to rethink and analyze his system. He thus has come out of a routine system, had to question himself again and he now looks more at his herd, observes the behavior of his animals. And this way, the farmer feels like the work is less humdum.

Through this project he also experienced group and collective exchanges with breeders who have the same approach. It is a real advantage and a real added value to the production objective.

Adoption criteria

From his point of view, everything is a question of will. Anyone can implement this innovation, if someone wants to get out of his system and to question himself, it is possible.

Indeed, in his case, even with low potential soils, he now manages to take advantage of it properly. One just has to think and adapt one's forage system to one's herd and not the other way around. Any system is perfectible according to him just dare to question old choice and invest.

Future prospects

According to him, programs like the one in which he participates (Herbe et Fourrage Centre) or Inno4Grass are a way to disseminate this type of project/questioning. For one time, when too many farmers have relied on an existing system without trying to change it, it must be shown that it is possible and effective.

Now the farmer would like to work tannin plants for example to try to reduce the medicalization.

He is also implanting new hedges of oaks and other trees because for him it will bring richness to its soil and thus to its meadows. But for him it can work even more in this direction with conservation agriculture alternatives ... that can improve the value of the soil and therefore grasslands.

For him the current threats come either from the rules: one should not constrain the farmers too much because sometimes it is not necessarily judicious. For example, it was previously forbidden to upturn permanent grasslands when they had no more potential, values and flora had become impoverished. Today, by redoing them, it brings back value to the ground, different species... From the moment someone comes to appreciate the fact that it is better before than after for the biodiversity of his meadow why would not it be possible to remake it? It is necessary to have rules but it is also necessary that if one brings the proof that it is positive anyway one can go beyond.

The current problem of our society is that everyone in all cases must apply the same rules while everything is not all black or all white.

And the second threat to which we will have to quickly answer is the climatic constraint. Extremely dry years like this year are becoming more commonplace. We will have to find ways to adapt our systems and our agriculture to this new climate. Look for example species from other countries that are able to withstand drought...

Pasture 10 km from the wintering building with dairy cows

Farm: **" GAEC d'Arazon"**
Location: **Vosges FRANCE**

Farm description

3.8 annual work units

Dairy cows and sheep combined

85 dairy cows and 65 ewes

Organic agriculture

Objective of productivity: 5000L /cows/year

Three main soil types:

- Superficial clay and limestone, deep of about 10 to 40 cm before the limestone rock (130 ha).
- Deep clay soil (75 ha)
- Deep clay soil, relatively close to the river with floods every year (15ha)

Climate

Climate is continental, with cold winter and warm summer. Rain are quite homogenous during the year excepted July and august witch are more dry and with thunderstorm. As for other regions, climatic hazards are more and more frequent and impact grasslands productivity. 2016 was a very rainy years. This amount of rains has impacted the quality of forage: the mows had to be report of 3 weeks at least as usual. 2017 was marked by a cold spring and a reduction of grass growth compared as a « normal year ». And to finish, the summer 2018 was warm and dry with a stop of grass growth since 1st July.

Background

The GAEC d'Arazon is composed of two farms combined in 2007.

First farm:

- The building can house 80 dairy cows
- Enough of storage capacity for forage to feed the herd during winter
- 15 ha of grassland available for pasture

Map of the first place, plots available for grazing are in red

Second farm:

- The old building can house about 50 dairy cows
- Not enough of storage capacity for the whole herd
- 73 ha of grassland available for pasture


Map of the second place, plots available for grazing are in red

After the fusion of these two farms, only the first place building was big enough to house the whole herd. The two places are 10 km far.

Detailed description

The solution was to keep the big building of the first place for house the herd during winter and to move the herd in the second place during summer to have enough area for the pasture.

The milking management could be solved with 3 options:

- 2 fix milking parlour, one in each place
- 1 mobile milking parlour
- 2 places for milking but only one mobile equipment (pumps, pipes…)

The investment was almost the same between these 3 options.

The last option was chosen, because of the ease of cleaning a fixed installation relative to a mobile. The disadvantage of the first option was that the equipment would only be used for 6 months a year, which is bad for machine maintenance (seals …).

Results

Farmers are satisfied of the installation. Equipment is moved twice a year and the pasture area of the second place is enough productive to feed the herd during all the season.

Advantages of the innovation	Disadvantages
Costless milking production during grass season, because of the valorization of the grasslands of the secon place	Moving equipment and herd take times
No need to rebuild a new barn and new storage capacity in the second place	Equipment can be broken during moving
Valorization of forces of each places	The cows don’t have a food transition : they have gone from 80-100% of conserved forages to 80-100% of grazing in one day

Perspective and threats

The innovation is not challenged by the farmers and seems to be well adapted of the context. The future ways of progress of the farmers is to manage a cattle and sheep combined pasture to limit parasitism and to have a better grass valorization.

Another issue is the accentuation of the heat and drought in summer : that can disturb grazing and make necessary to feed animals during summer with conserved forage, which involve to build new storage capacities in the second place or to moving two more times the equipment and animals.

Renovation of permanent grassland in the farm

Farm: **" Gaec de la Basse Cour "**
Location: **Calvados France**

Background

<u>This organic farm comprises</u>:

- 137 dairy cows, 190 LU
- 175 ha of grassland, mainly permanent and 25 ha of crops
- 3 full time employees

<u>The environment of the farm is based on</u>:

- Medium clay for the soil
- Temperate and oceanic climate, due to the cost with an altitude of 30m

<u>About grassland management</u>:

Dominant meadow species (after renovation) :English Grass Ray, Tall Fescue, Meadow Fescue, Timothy, Purple Clover, Hybrid Clover, White Clover, Chicory and Plantain

Interculture composition (stolen culture) : Fodder Rape, Italian Ray Grass, Diploid Oats, Oats and Radish Forage

Types of forage conservation :

- Hay (drying in barn)

- Wrappers

Detailed description

Organic system based on grassland system with conservation methods in hay (dried in barn) and wrapping. The goal is to graze with 70 ha accessible for cows.

Permanent renovation of permanent meadows (since 2015) with planting of a stolen crop (intercropping) in the spring or autumn, which is pasture (5 pastures) and then destroyed for reseeding the permanent meadow (multi-species) to next spring, composed of English Rye Grass, Tall Fescue, Meadow Fescue, Timothy, Purple Clover, Hybrid Clover, White Clover, Chicory and Plantain.

Multi-species grassland seedlings in 4 stages : destruction of rotavator intercropping, 2 cover-crop passages, sowing of the meadow in the combined seedbed and 2 passes of cultipacker roller.

Results

This is a very successful technique for the moment, with a benefits from dairy production (especially during inter-crop grazing) and the presence of clover in the permanent meadow thanks to spring sowing.

This technique has been put in place to increase production and therefore products and reduce food costs.

Adoption criteria

Farmers start a program of renovation of permanent grasslands (after a trip to Finistère, Brittany) for a better production, especially in summer.

They pay attention in the renovation of meadows with the establishment of intercropping before the sowing of the meadow to clean the soil while maintaining good productivity.

They sow the meadow in the spring because it’s too wet in the fall.

The success is due to an optimal recovery of multi-species grasslands through barn drying.

Future prospects

Wishing to generalize this innovation to all the meadows to be renovated in order to improve as much as possible the food values of grazed meadows and distributed fodder.

This innovation can be disseminated to the means of:

- pasture promotion events, type "Prairiales"
- specialized websites
- exchange forums

The limits identified: the climate at the time of sowing, the absence of plowing which requires to mechanically destroy the cover of intercrops and the cost of seeds quite high in organic farming.

A collective hay dryer in barn

Farm: **“GAEC de la Bos”**
Location: **Mayenne FRANCE**

Background

Stéphane LORIN's farm (GAEC de la Bos) is located in the west of France, in the north-west of the department of Mayenne. In this area, the climate is oceanic, and the soils are generally healthy and silty-clayey. This is therefore a very favorable context for the growth of grasslands. It is a region where dairy cow farming is the most common animal breeding system. Forage systems rely on pasture harvesting from March to November, and on corn silage to fill periods when the grass is not or not enough productive. The use of protein concentrates (especially soybean and rapeseed meal) is therefore very common.

Thus, 2016, an anaerobic digestion unit and 24 farmers from the sector, have joined forces to valorize part of the heat of the methanizer by drying high-protein forage. They have created a collective drying unit, and organized themselves to supply it regularly and continuously. Among these farmers, Stéphane LORIN of GAEC de la Bos is today the president of this organization. For the biogas company, the objective is to be able to recover the heat produced by the methanizer, which also produces electricity. For farmers, the organization's interest is to be able to produce protein-rich feeds at a reasonable cost, thus gaining autonomy, being less dependent on inputs, and reducing production costs and workload on their farms.

Detailed description

Stéphane LORIN, like every other farmer in the group, has signed a contract with the company that operates the anaerobic digestion and drying unit. In this contract, he has pledged to dedicate some grasslands, alfalfa or red clover, to the production of dried fodder. In return, the company that operates the methanizer and the dryer has pledged to dry the fodder produced, and is responsible for the harvest, as well as the delivery of dry fodder on the farm.

Therefore, the farmer is responsible for the agronomic management of the area involved. He thus deals with the sowing, the fertilization, and possibly the weeding of his grasslands, alfalfa or red clover. He is also responsible for mowing, tedding and swathing of his plots. The farmer does not pledge to deliver a specific volume, or even to provide a sufficiently dry fodder to facilitate drying operations (60% DM approximately), but he tries, as much as possible, to inform the manager of the dryer, and provide him with a forage easy to dry.

After being dried, the forage is analyzed and returned to the farmer. He is therefore responsible for its storage and preservation, and has the information to integrate it into the rations of his animals in production. He is responsible for adapting to fluctuations in the quality of the produced forage his feeding system.

To manage all these parameters, and progress in the control of these forages, Stéphane and all farmers in the group are accompanied by the Chamber of Agriculture. Each year, an advisor regularly visits the dedicated plots, and exchanges with farmers on all technical aspects, from agronomy to animal valuation. It determines in particular a schedule of harvests, which is suitable for both the farmers members of the group and the manager of the dryer.

In this context, the farmers and the advisor set up a number of tests in order to respond concretely to the problems they face. These tests range from the agronomic management of fodder to animal valuation. The farmers group also meets regularly to organize themselves, coordinate with the dryer, and share their successes and failures. The purpose of these exchanges is to bring the group to collective progress.

Results

In 2018, 739 tDM of fodder was dried. In 2017, it was 653 tMS. Alfalfa accounted for almost 60% of the volume produced in 2017, and it was reduced to 50% in 2018, to give more space to forage that can be harvested in offset (grasslands based on Italian Rye-Grass, or flora varied grasslands, and red clover).

Yields achieved between 2017 and 2018 have not improved. On the other hand, the crop chains were more efficient because the fodder remained on the ground an average of 13 hours less between mowing and harvest, and was harvested on average with 11% more DM.

Regarding animal performance, there was an overall reduction in concentrate purchases of 7% between 2016 and 2018. The contribution of innovation in terms of autonomy is still quite modest.

However, most of farmers have noticed significant gains in productivity and / or quality of the milk produced (fat and protein rate), since the incorporation of forage from the dryer into the dairy cows diet. Overall, it was also noticed that the general health status of the animals has been improved. Metabolic diseases, as well as reproductive problems are a priori less common since the introduction of these fodder.

As far as farmers are concerned, so far it does not seem that fodder has an impact on the economic results of farms (neither positive nor negative). The high cost of these fodder is today more or less offset by the best animal performance. Regarding workloads, it has been noticed that the storage type of products (bulk) significantly reduces the rations preparation time, as there are fewer tarpaulins and strings to handle.

Adoption criteria

The first success factor of a collective drying unit is that the forage drying unit must be very close geographically to each of the member farms. In the case of the Nord-Mayenne group, all farmers are within 15 km of the methanizer. Already, for those who are the furthest away, the cost of transporting fodder means that their economic interests are lower, which makes them less likely to strongly develop the partnership.

In the same way, the project works because, on the one hand, the pedoclimatic context is very favorable for the growth of legumes and **grasslands** specifically intended for this use. In parallel, these are systems in which the forage produced is particularly well valued by animals. In less favorable contexts and / or in more self-reliant and less dependent livestock systems, the economic stakes involved in this type of approach would probably be less important.

Finally, the project works today because the different actors are accompanied and coordinated. The diversity of crops to be valued by the dryer is, for example, essential to the good functioning of the system as a whole. Indeed, this diversity allows to spread and distribute the harvest dates within the group, and thus allows the drying unit to operate continuously, without being saturated. Thus, the work of accompaniment and coordination between the members of the group is essential to avoid that everyone is aiming for the same harvest periods, and that this does not get into significant quality decreases in the finished products, which can generate tension within the group.

Future prospects

In 2019, the capacity of the dryer, as well as the quantity of available heat will be doubled. The project will open up to other farmers in the region. A new stakeholder has already joined the project. In the already-members farms, the committed surfaces will also be increased, because the fodder obtained are satisfactory.

The expertise of the general agronomy of this type of fodder, the chains of harvest, as well as the processes of drying, and of valuation animal are in good way. However, there is still room for improvement, and means have been and are being mobilized to meet them in the future.

The economic interest of the innovation is not yet obvious. However, good hopes for progress on the added value of these fodder in terms of animal production emerge within the group.

However, the organization of the harvests between the different members remains and will remain the main limit of the project. Climatic windows are limited to produce good fodder, as well as the capacity of the dryer. It will be difficult to guarantee optimum forage quality for each of the harvesting sites. In the West of France, anaerobic digestion projects are multiplying, and some project promoters are looking closely at what is being done within the group, why not use heat for this purpose. However, this constitutes a rather heavy additional investment for the structure exploiting the anaerobic digestion, and is viable only if there is a sufficient number of dynamic farmers around for the project, which is fortunately the case for this North Mayenne group.

Regular cuts of temporary grasslands

Farm: **"GAEC du bourg de l'Abbé"**
Location: **Seine-Maritime FRANCE**

Background

The farm comprises:

- 70 dairy cows, Pie Rouge breed, in a specialized dairy cattle system
- 110 ha UAA
- A grass-based system with 66 ha of main forage area including 35 ha of temporary grassland, 17 ha of permanent grassland and 14 ha of corn silage
- Stocking rate: 2.1 LU/ha Main Forage Area
- Production per cow: 10 600 L of milk
- 2.3 annual work units

The environment of the farm consists of:

- three types of soils: Clay, Limestone and Earthy
- A temperate ocean climate suitable to grass harvesting

Concerning grassland management, the criteria are as follows:

- permanent meadows composed of multi-species mixtures: English rye-grass, Cocksfoot, Fescue and White Clover
- temporary meadows composed of: English Rye-Grass and White Clover or recently a suitable mix for green feeding (practiced by the farmers in autumn and early spring) with long-lasting Rye-Grass varieties, namely, Italian Rye-Grass, White clover and Vetch.
- 60% of the grasslands are exclusively mowed and 23% are exclusively grazed
- 5 cuts per year are carried out on exclusively-mowed grasslands
- type of forage conservation: silage and hay

Continuous grazing is used to manage the dairy cows. The grazing period lasts 6 months per year.

All grasslands are fertilized with up to 120 units of mineral nitrogen.

Grasslands that are exclusively mowed receive an additional 45m^3 of clean slurry (0.6 µN).

The technical expertise that innovation implies is one of the greatest farmers' motivators.

The innovation is part of the farmers' desire to achieve reasonable goals with a good distribution of the workload while aiming at the food autonomy of the current system.

This innovation was inspired by a trip to Holland in 1983, when Jean-Michel Heurtaux (the father) got on the farm. Since then, the farmer has been working with a system based on growing grass, with a limited amount of corn and many temporary grasslands harvested as silage with a high dry matter content ("haylage"). This system has adapted to the constraints of the farm situation (Natura 2000, watershed, etc.): in a valley, with paddocks on hillsides and along river banks.
In addition, the grazing of dairy cows was maintained despite the setting of a milking robot at the end of 2011, and the old permanent grasslands are gradually being renovated (with a mixture of Hybrid Rye-Grass and Red Clover at first because of its aggressiveness at establishment).

Detailed description

The innovation on this farm is to regularly mow the temporary grasslands at the right stages to optimize the yield and value of the harvested forage.

Its implementation follows several failures in forage harvesting.

The strategy of the breeders is based on a good knowledge of the good forage harvesting stages, thanks to certain natural landmarks and food value analyzes carried out which allow to place themselves for the following years.

The farmers proceed as follows concerning the harvests:

- on temporary grasslands:
    - 1st cut end of April
    - 2nd cut end of May
    - 3rd cut end of June
    - 4th cut end of July-early August
    - 5th cut late August-early September
    - Then grazing by heifers

That means 4 silage cuts and the 5th cut in hay.

- on permanent grasslands:
    - 1st cut end of May in hay
    - 2nd cut in silage

They use a mower-conditioner that scatters the grass across the cutting width, which avoids haymaking. In general, only one haymaking is done in the spring and no summer.

The farmers swath and harvest with a self-loading machine after 2-3 days of drying on the ground. About 1 ha is harvested per trip thanks to a $30m^3$ Bergman Royal self-loading wagon.

The different cuts are placed on top of each other in the silos, which makes it necessary to cover and dismantle each silo on average two times.

Results

This innovation initially allowed a better distribution of the workload in the spring and summer with regular harvests, however, but very fast with the use of the self-loading wagons.

In a second step, the innovation allows to harvest grasslands at a young stage, to obtain a better food value. This good control of the harvest stages promotes a good balance of animal rations.

Finally, at equivalent production, ie 29 kg of milk per cow, the quantity of nitrogen correctors has been halved since the introduction of the innovation. That is 1.5 kg of ”VL 40” instead of 3 kg which would be necessary in conventional ration.

Silage has a high dry matter level (50 to 65%), which promotes ingestion and improves the digestible protein from diet value.

Adoption criteria

The success of this innovation lies in the will of the farmers of an optimum valorization of the grass. This is the first factor in the success of this innovation.

It involves having a good technical expertise in the management of the grasslands and knowing how to appreciate the different stages of the species to harvest the grasslands at its best stage.

Future prospects

Barn drying is planned to go even further in improving the value of harvested forage and in order to save input costs by setting up a methanizer that is currently under study.

The setup of the methanizer is planned for the second half of 2020. The setup of the dryer will be done in a second time.

This innovation can be disseminated by means of:

- grazing promotion events, such as "grass fair", "Prairiales", ...
- specialized websites
- exchange forum

Threats or fears that may slow down the development of this innovation include:

- the time that it takes; however, the work is more spread over time than with a system mainly based on corn silage, but there are plenty of grass crops to be expected: in spring and summer, "every month we must mow".
- potential modifications of harvest stages linked to global warming; harvests that may interfere with other farm work. A drier climate in summer could also penalize the regrowth of the grass after the harvests and thus limit their number.

1-day-by-paddock grazing system

Farm: **"GAEC de la Charmée"**
Location: **Vosges FRANCE**

Farm description

3 annual work units

Dairy and beef breeding and crops culture

110 dairy cows

Objective of productivity: 8000L/cows/year

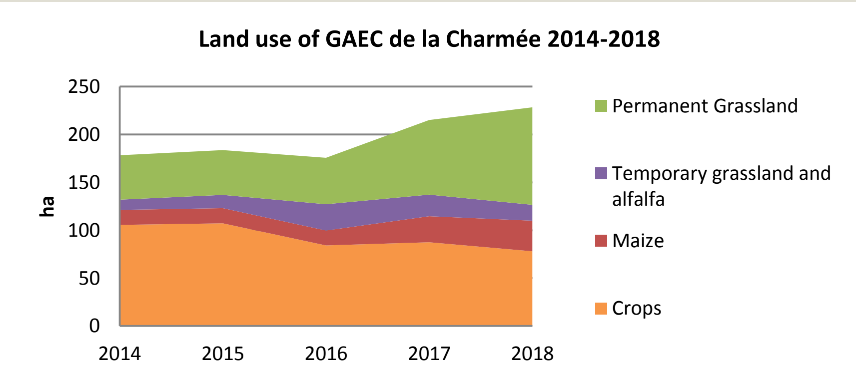
Effective production :

- 2016/2017 : 7500L /cow/year
- 2017/2018 : 7000L/cow/year

Three main soil types :

- Superficial clay and limestone, deep of about 10 to 40 cm before the limestone rock. (74 ha)
- Clay and limestone, deep of about 40 to 70 cm before the limestone rock (111 ha)
- Deep clay soil, relatively close to the river (43ha)

Evolution of land use from 2014 to 2018:



Climate

Climate is continental, with cold winter and warm summer. Rain is quite homogeneous during the year except during July and August when it is drier and there often are thunderstorms. As for other areas, climatic hazards are more and more frequent and impact grasslands productivity.

2016 was a very rainy year. This amount of rain has impacted the quality of forage: mowing has had at least 3 weeks beforehand from usual timing.

2017 was marked by a cold spring and a reduced grass growth compared to a « normal year ».

Summer 2018 was warm and dry and grass has stopped growing since the 1st of July.

Background

The GAEC de la Charmée has comprised Régis DURANT and his wife until May 2017. From that time, their son has joined the farm, they have lent about 50 ha of UAA more, all in permanent grassland, and double their livestock.

The farm lands are not all good enough for maize production. The possible maize area is limited to 35ha. However, simulations made during the installation of the son showed that the needs of dairy and lactating cows should be covered by 50 ha of maize, in the current feeding system. Thus the farmers have chosen to have a better use of grazing areas, with the setting of a 1-day-by-paddock grazing pattern, which replaces the old pattern with wire, so that the needs of the cows could be covered with only 35ha of maize.

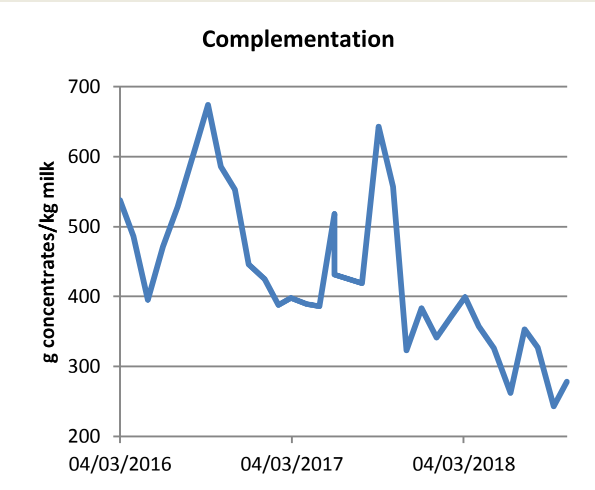
Detailed description

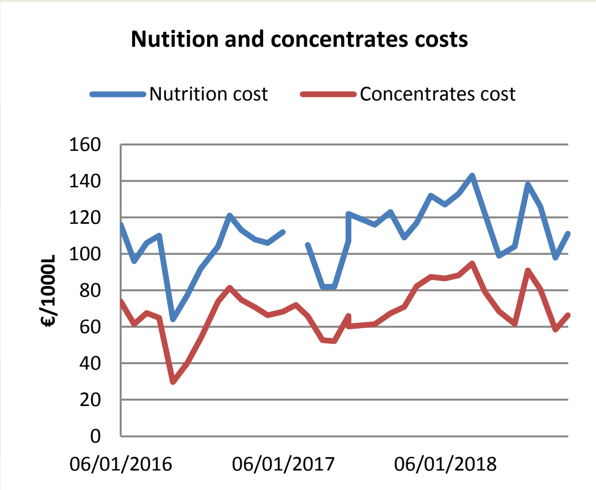
The 32 ha around the farm building are divided into paddocks of about 1.1 ha each. All the dairy cows are grazing, generally from the 1st April to the 1st November. Since the setup of this grazing system, every year, the climate was abnormal (drier, rainier…), so the results are to be analyzed carefully.

Results

Several indicators have been measured from 2015:

Feeding :



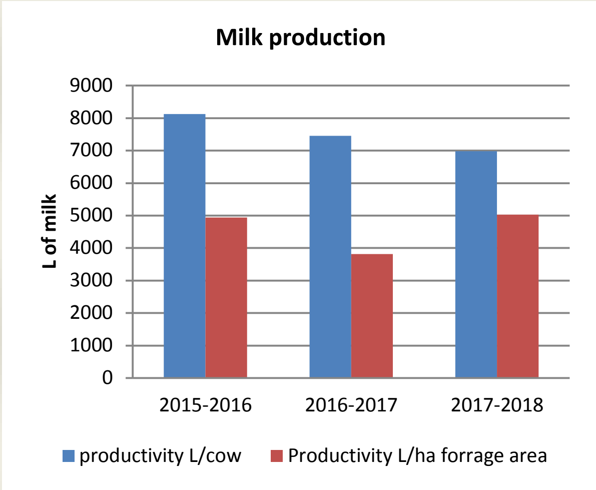


This new grazing management has allowed decreasing by 14% the quantity of concentrate to produce 1kg of milk between 2016-2017 and 2017-2018. But concentrate costs have increase because of variations of the global price of soybean and other feeding stuff.

Production

Milk production has been measured in two different ways: the production by cow and the production by ha of forage area.

The grazing management evolution has allowed to maintain the productivity by ha. But the milk production by cow has decreased. Several causes can explain this: climate impacts, transition between two grazing systems, adding new cows to the herd and their adaptation etc.



Work condition

There is no easy indicator to follow the evolution of work condition. M. Durant has the feeling that the new grazing system represents less work than the old one.

Perspectives and threats

In a close future, the farmers will upgrade their system installing water supply for each paddock. That will allow less work time and better work condition. It will also allow increasing grazing performances. Indeed, for the moment, a cow must return into the building to drink, which is grazing time and energy loss. Pathways have to be reinforced to allow an easier cows' mobility.

In a more distant future, the farmers will grow trees and bushes at the right places in the plot to bring shadow to the cows and increase animal welfare.

Climate change is a real challenge for this type of system. Indeed, prospective shows that average temperatures in June, July, August and September will have an important increase (to reach an average of 25°C in August at the end of the century). In parallel, rain will decrease during summer. Some questions stay in suspend about the possibility to graze earlier and later in the year (but what about soil support capacity?).

Maximize grazing with automatic milking

Farm: **“GAEC de la Saulaie”**
Location: **Maine-et-Loire FRANCE**

Background

The farm has 100 ha of UAA valued entirely by the herd of 68 dairy cows. The aim is to optimize pasture while improving the quality of life of both the farmer and his wife (no employee). They chose to install a milking robot in 2010 to no longer have the strain of milking.

The farm is bordered by two roads. Cows grazed on the other side of the road before the milking robot was installed. Since the robot, the accessible surface has been reduced to 9 ha, the cows having to access the plots without the farmer.

The couple wants to maximize pasture to reduce the cost of milk production and ensure food independence. The farm started a conversion to organic farming in 2016.

Detailed description

Increase the accessible surface

The partners first made a parcel exchange with a neighbor, to recover 4 ha. In 2016, they built a boviduc to access 11ha located on the other side of a road. The boviduc was 100% self-financing. It cost 17,000 euros.

An effective rotational grazing that facilitates the moves of animals

The plot is cut into paddocks to practice a rotating pasture. The 21 ha accessible are divided into 30 paddocks. The goal is to motivate cows to graze grass at a young and appetizing stage. This is as much important as the cows have to go to the pasture on their own with the milking robot. The rest period between two grazing periods for the same plot is 30 days.

An easy circulation for the cows so that it is not necessary to go find them

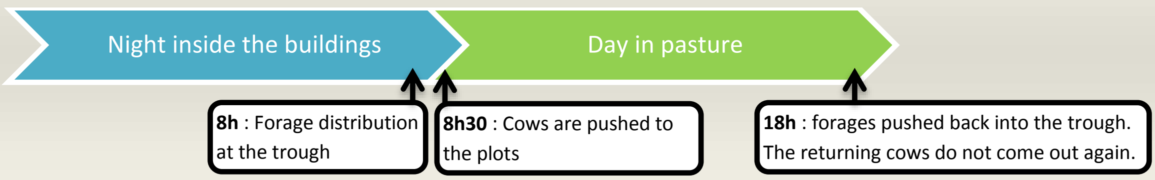
A key point of grazing with a milking robot is to ensure a smooth flow of animals. There are 24 day paddocks and 6 night paddocks. Changing paddocks twice a day motivates cows to move between the robot and the plots. The cows spend 2 days per day paddock and 4 nights per night paddock. There are no troughs on the plots to encourage the cows to return to the building to drink. The paths are stabilized on 50 meters at the exit of the building.
On a daily basis, breeders avoid being too present. They push the cows to go out to pasture in the morning in transition period but never go to find them in the field.

An unsaturated robot and a sorting gate limit the interventions of the farmers

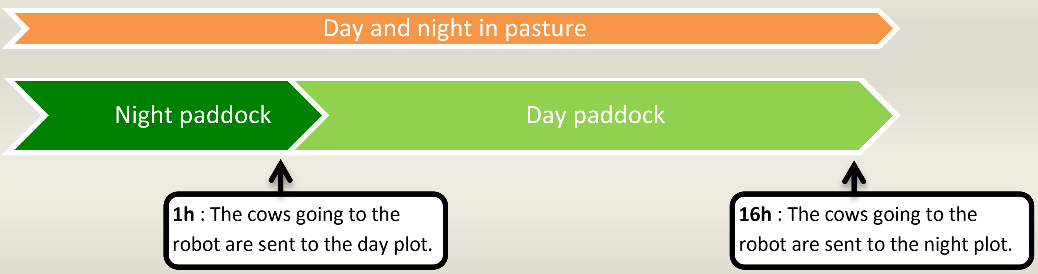
The average number of milking is 2.2 milking/cow/day. The robot is used 70% of the time in the spring with 65 cows milked. The farmers do not want to saturate the robot in order to facilitate grazing management.
An intelligent sorting door is the exit of the building. It directs the cows either to the pasture or to the building if they have not been milked for a long time.

Organization of a day for dairy cows

In food transition period (beginning and end of spring + autumn, 2 months / year)



In full grazing period: from April to June (no food distribution, 3 months / year)



Management of pastured grasslands

There are 40 ha of grassland on the farm including 30 ha of multi-species grassland mainly grazed. They are kept as long as possible, 10 to 15 years.

Due to the organic label, there is no mineral fertilization. Pastured grasslands receive the equivalent of 30 µN/ha/year.

Results

Food autonomy and few purchases of inputs

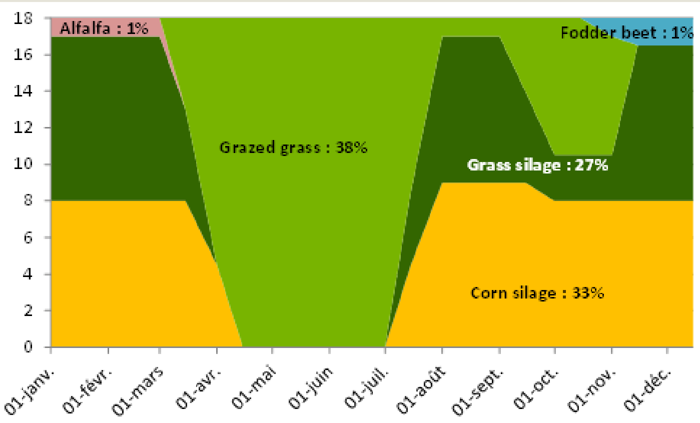
95% of the fodder is produced on the farm. The farmers avoid unnecessary stocks by focusing on grazing. Preserved fodder comes mainly from 12 ha of silage maize, 12 ha of hybrid rye-grass and red clover mix and 3 ha of alfalfa.

Concentrates are 90% self-produced. These are cereal-protein grain mixtures. The mixture is flattened on the farm and distributed to the milking robot (2 kg / VL / day on average). For 3 years, the farm buys 5 tons of soybean meal / year.

Pastured grass represents 50% of the fodder consumed

Pastured grass accounts for 38% of the dairy cow's ration.

Annual feeding schedule for dairy cows at GAEC DE LA SAULAIE



Modest production per cow but low food cost

Cows produce 6,500 liters/year on average. The farm sells 430,000 liters of milk/year. This level of production is consistent with the autonomous grassland system.

The food cost is about 120€/1,000 L. The selling price of organic milk in 2018 was 470€/1,000 L on average, which leaves a margin of 350€/1,000 L on average, which is satisfactory. EBITDA on gross product is 54% in 2018.

A work organization that fits with family life

The farmers feel that there is little stress in their work. The spread calving period allows to distribute the work over the year and reduces the strain with the robot.
The strain work represents 5h/day for the couple (2h30 / day each). Over a year, the two partners accumulate 3,500 hours of work, which corresponds to an average of 35 hours / week each.
The replacement for vacations or weekends is facilitated by a simple feeding system.

Adoption criteria

According to Christophe MALINGE, the evolution must be progressive. He first learned to master the rotational grazing, then set up the robot, landscaped the plot, then went organic.

The accessibility of the paddocks seems very important to him: he advises to have at least 25 to 30 acres of accessible grass / cow.

One must be convinced of the interest of grazing and give oneself the means: to provide good access (paths) and to organize the circulation. The grazing needs to be expanded to make it profitable. The locations of the robot and the sorting gate in the building are important for fluid moves of animals. According to him, a sorting gate is useful from 55 cows / stall.

Finally, one has to accept reductions in production at certain times because one knows that it is economically interesting. Do not be afraid to take risks. It can be disconcerting to decrease production when equipped with a milking robot. At some times, with 100% grazing, their cows only produce 16 liters / day and yet it is a profitable strategy.

Future prospects

What could be further improved?

- The aim would be to increase production to 7,000 L / cow / year. They have not reached it yet in 2018 because of a difficult grazing start in the spring of 2018.
- Work on grassland mixtures adapted to drought, with yield, and which are palatable.
- Have a smartphone tool to record grazed grass, or a grazing calendar that allows you to value the data.

What could be the risks for other breeders to adopt this innovation?

- Grass systems are very dependent on the climate.

How to communicate and disseminate innovation?

- Participate in exchange groups
- Before starting, he advises to look for information, go to see other breeders.
- Investments should be subsidized that favor grassland systems: boviduc, parcel exchange, self-loading wagons ...

Mob-grazing with a large herd

Farm: **“GAEC du Tertre de Villeray”**
Location: **Mayenne FRANCE**

Background

This farm is a family business with five partners located in the north of Pays de la Loire, in Mayenne district. It’s a specialist dairy farm with cattle rearing. The dairy herd is composed by 165 Norman cows, they produce 1.1 million litters of milk. Twenty or so oxen are fattened on pasture each year to run permanent grassland area.

The 330 ha of agriculture area are composed of 218 ha of forage area and 112 ha of annual crops (wheat, barley and rapeseed). The main forage area is composed of 69 ha of corn silage (whole plant is harvested or only corn cob ensiled), 71 ha of temporary grasslands and 78 ha of permanent grasslands.

The main objective of farmers is to improve working conditions (research of simplicity, comfort and efficiency) without decreasing economic results. They want to reduce feeding cost by increasing grazing in cow diet. They have increased grazing area and have implemented a one-day (24 hours) rotational grazing management.

Detailed description

Increasing of grazed grassland area

The grazed grassland area allocated to dairy cows increased by twenty hectares between 2017 and 2018. 56 hectares are available for grazing 165 dairy cows.

Implementing a new pasture management to improve grass utilization

Farmers have implanted mob-grazing to improve grass utilization: a rotational daily grazing management. Before according to the plot size, cows have been moved every 3 to 7 days. Now, they are moved in a new plot every day. Farmers divided pasture area into 33 plots of 1,70 ha. They used a mobile app "Field area measure" to locate fences. In each plot, the entrance and exit are different. Water troughs are moved away from the entrance of the plots. New cow paths have been laid out to drive cows to new pasture area. Purchasing costs are estimated to

Grazing management

Grazing is managed with the help of sward height. Grass heights are measured weekly in each plot with a grassmeter. Farmers put cows into paddock when sward height is 10 or 12 cm. Cows enter a new paddock morning or evening interchangeably. They are grazed to a target sward height of 5 cm. In late spring, when there is too much stem and some ears, farmers implement « topping », they cut the grass before the cows graze. Cows are supplemented with 2 or 3 kg of corn cob silage while the part of grazed grass is the highest to maintain the level of dairy production.

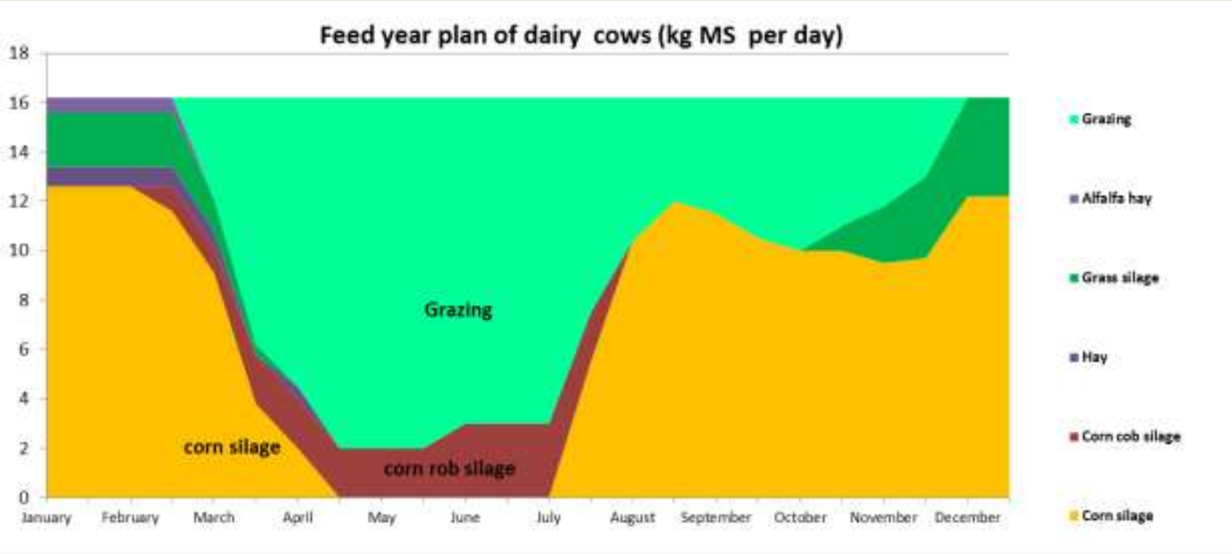
The farmer register his practices in a grazing schedule: the number of grazing animals, the grass quality, the severity of grazing, forage and concentrate complementation.

Results

The farmer is satisfied with his new grazing management. Grazing was more homogeneous than before. Plots were grazed out better by moving water troughs. Dairy cows move easily. It's easier to fetch the cow out a small plot.

The grass intake is better: 7,3 tons per hectare on average, from 4,7 to 11,6 tons according to the paddocks.

The increase of grazed grass part of cow diet has been achieved by increasing area available for grazing and a better pasture management. In 2018, the turnout was done 1,5 months earlier than previous years (on February, 27th against on mid-April).



Grazed grass makes up 40 % of dairy cow's diet in annual average. It makes up between 50 and 60 % of cow's diet during grazing period and near 90 % in spring.

50 tons of soybean cake have been saved.

Recording data (grazing plan, grazing time, supplementation, grass intake…) makes farmers more aware on possible improvements of their grassland management, particularly it allows them to identify the less productive plots which need to be renewed.

This new grazing management was implemented in 2018. Beyond the realized soybean economy, economic results are not yet available (accounting closing on April, 30).

Adoption criteria

Adoption criteria

The temperate oceanic climate is in favour of grass growth (760 mm of annual rain). A large area is available to cattle grazing: 60 hectares around the barn. The entrance of the farthest grazed plot is 900 meters from the dairy building. Soil diversity is well suited to livestock grazing system and allows a long grazing period. Some soils with a good bearing capacity allow an early turnout and the grazing period could be longer over summer according to deep loamy soils.

The farm is included into the Pays de la Loire grass monitoring network. It is established by the chambers of agriculture. Sward height is measured weekly during the grazing season by a technical advisor and the data were used to calculate grass growth. Thereby, farmers have the data to manage grazing.

Beyond these elements, the adoption of this system comes first and foremost by the breeder's motivation. His aim is to graze his cows rather than driving tractor to feed them.

Farmers accept a lower dairy yield per cow to improve feeding cost. Their aim remains to produce their milk quota by increasing the number of dairy cows on grazing period, and not overloading the building during winter period.

Improvements, threats, future prospects

The farmer needs to confront his system to different climatic years. Using different plots daily and nightly could be the next step in the improvement of grazing management. A special attention must be given to water network, especially to the size of the water troughs. In the farm, some water troughs are too small and need to be changed before the next grazing season. Paths are also very important to achieve easy cow traffic.

The milk is delivered to a dairy enterprise which have paid GMO-free milk 10 €/1000 l more since January the 1st. Farmers don't use soybean cake anymore. It could be a new motivation for farmers to increase the grass part into dairy cow's diet.

With their large herd, farmers think about separating dairy cows into batches according to their lactation curve, in order to adjust the level of supplementation.

Self-made tools: combine press and bale wrapper

Farm: **"Jean-Luc Gaultier"**
Location: **Indre FRANCE**

Farm description

> 1 annual work unit

> Beef breeding

> 109 LU with 60 cows, Limousine breed

> 80ha all forage crops: 12ha of permanent grassland and 68 ha of temporary grassland

> Soil type: loamy-sand and clay

> Production: 14 month-old slaughter, 400 kg of weight, average ranking U +

Climate

Temperate oceanic climate with, in recent years, many summer droughts.

Background

The farmer is alone on the farm, he had to find a solution to make his wrapping work quick and cheap. Indeed, in the absence of his innovation, the breeder could either buy a second-hand combined press and wrapping machine that costs between 20,000 and 60,000 € or he continues with both machines but it means two field trips and therefore double working time. He thus combines economic gain and time saving.

Detailed description

M. Gaultier rotates on these plots and on the whole of his Main Forage Area he uses 96.25 in both mowing and grazing. For the feeding of his cattle he makes both wrapped and dry hay.

It presses and wraps in a single tractor for 15 years. For this, he wears a press (New Holland Rollbelt 150) on the tractor and a wrapper (Mc Hale HS2000 Bale Wrapper). This technique, much less expensive than the purchase of a combined press / wrapper, is however not very widespread in our campaigns.

Results

This innovation allows the farmer to do his wrapping at the right time, quickly and in good conditions.

He thus gains in working time, he realizes an economic gain compared to the purchase of a combined machine.

Moreover it allows him to make early mowing and thus maximize the nutritional value of his forage and the growth of his meadows.

Adoption criteria

This innovation can work on all plots that can be mechanized and do not have a steep slope so that the ball remains in the axis of the envelope. It takes the habit and the hand of the practice but it is easy and accessible to all.

The farmer does not understand why there are so few farmers using this technique.

The saving in comparison with the purchase of a combined machine remains significant in the current context of the farm economy.

Future prospects

The breeder wishes to continue working in this way and does not wish to change his practice, that brings together all the advantages.

No threats or obstacles to this innovation for the breeder. The lack of knowledge of the technical possibility of other farmers may be or the desire to always have the latest equipment.

Upgrade the grazing system with cross breeding

Farm: **“ Lycée agricole de Pixérécourt ”**
Location: **Meurthe-et-Moselle FRANCE**

Farm description

2.5 annual work units

Dairy cows and sheep combined

75 dairy cows and 200 ewes

Objective of productivity: 5300L /cows/year

Two main soil types:

- Deep clay soil (50%)
- Sandy-loam (50%)

Climate

Climate is continental, with cold winter and warm summer. Rain are quite homogenous during the year excepted July and august witch are more dry and with thunderstorm. As for other regions, climatic hazards are more and more frequent and impact grasslands productivity. 2016 was a very rainy years. This amount of rains has impacted the quality of forage: the mows had to be report of 3 weeks at least as usual. 2017 was marked by a cold spring and a reduction of grass growth compared as a « normal year ». And to finish, the summer 2018 was warm and dry with a stop of grass growth since 1st July.

Background

The farm of the school of Pixerecourt has 280 ha of agricultural area The dairy herd is fed only with grass as frequently as possible. The pasture area is close to a river. It is possible to graze generally after the floods, at the end of march. In these conditions, the weight of a cow is a disadvantage for grazing because of the degradation of the grass cover. That’s why the farm manager has chosen cross-breeding: to reduce the weight of the cows and maximize their ability to graze.

Detailed description

The herd was only comprised of Prim’holstein cows until 2009. While creating rotational scheme for grazing, the farmer has begun cross-breeding.

Fistly he tryed with Montbeliarde and Normande, and now the breeds available on the farm are:

- Prim Holstein
- Montbeliarde
- Normande
- Jersiaise
- Rouge scandinave

For each cow, insemination is determined by the weakness of one of these characters:

- Milk productivity
- Milk quality
- Weight
- Health, especially the robustness of the legs

The pasture is divided in 26 paddocks of 1.5 ha. Cows stay on these paddocks between 1 and 3 days according to grass growth.

Results

The average weight of cows is decreasing to reach 500-530 kg. The management of pasture allowed decreasing the time of work of the employees.

Now, cows are producing 5300 kg milk/year/cow with 250 kg of concentrates, without silage of maize.

The aim is to maximize the production of milk relative to the live weight of the animal.

Perspective and threats

One of the main difficulties of the innovation is to decide which breed to choose for crossing with each cow. There is no Help Decision Tool and no references of the results of each cross-breading.

To limit the low-productivity of grasslands in summer, the farmer tries to reseed chicory and plantain on the paddocks close to the building. Management of the chicory remains a difficulty, because of the fast past of the grazing stage.

The new farm manager is interrogating the abandon of maize, and will certainly cultivate it again.

Adapt grasslands to climate change

Farm: **"Stéphane Maigrat"**
Location: **Vosges FRANCE**

Farm description

1 annual work units

Dairy cattle

45 dairy cows

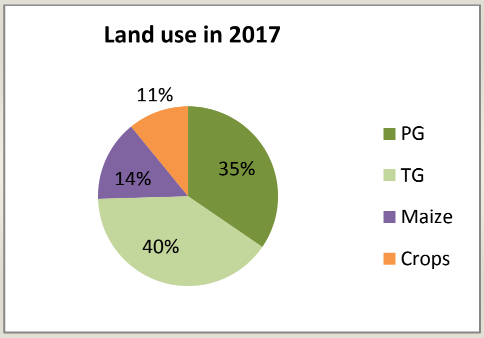
Objective of production: 8000L/cows/year

Effective production :

- 2014/2015 : 8200 L/cow/year
- 2015/2016 : 7550 L/cows/year
- 2016/2017 : 7200L /cow/year

Two main soil types :

- Superficial soil on marl
- Deep clay soil



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And to finish, the summer 2018 was warm and dry with a stop of grass growth since 1st of July.

Background

The soils of the farm are very dry in summer. The grass growth during summer never was important, but last years, it is absent. The farmer wants to reduce his maize and soy consumption to reduce the cost of production of his milk. To reach this goal, he needs to maximize grazing and so maximize the growth periods of his temporary grasslands. That why he chooses other species for his mixture: classic species as dactyl and fescue; and original species like sainfoin.

The choice of these species is guided by the drought and heat tolerance of the species. Indeed, the farmer notes that drought periods are more and more frequent and impact his forage management.

The reduction of concentrate in the herd feeding is financially helped by an agri-environmental measure (CAP). The measure also imposed a maximal rate of maize in the UAA.

Detailed description

The farmer replace his old mixture based on perenial ryegrass by a new one, based on dactyl and tall fescue. These two species are more tolerant to drought but more difficult in the use with grazing. Indeed, the leaf of dactyl and fescue are hardening quicly when the optimal stage is over and become uneatable by the cattle. The farmer had to have a better management of the pasture to avoid wasting grass and losing milk production.

The other innovation, for the same reason, is the introduction of sainfoin in the cultural rotation. Sainfoin is a species which is no more cultivate in this area since more than 30 years (and the introduction of maize as main forage ressource). Nevertheless, it is a plant very adapted to the local context and very tolerant to water stress.

Results

At the beginning of the agri-environmental measure and of the implantation of new TG, in 2015, the reduction of maize silage led to a decrease of the milk production. Moreover, 2015 and 2016 were two bad years for forage cultures, grass and maize both. However, some first results can be investigated.

Multi species mixture for grazed TG are efficient and allowed to graze about 1 month more than a perennial ryegrass during summer. The TG stay green even in august and even if there is no growth. This mixture allows a re-growth in autumn quicker and more important than a single species TG.

The change of feeding for dairy cows, with less maize and more grazing grass had a different impact depending of the breed. Prim'Holstein were very impacted by this change with a big decrease of milk production ; much more than the crossbreed cows (Prim'Holstein x Brune des Alpes) which seems more adapted to a grazing system. This impact could seem anecdotic but was very important for the farmer, who was very attached to the genetic of his herd.

The sainfoin stays a plant well adapted to the area, in very superficial soil. The annual production is about 70% for the first cut. The forage of sainfoin is very sweet and eatable by cattle. It is also very fibrous and rich in protein. For the first experiment, it was destined to the calves, because of the presence of healthy molecule in the sainfoin (especially for the liver).

The main difficulties are:

- The seeds cost: sainfoin is not a current forage species, so the seeds costs are high, about 300€/ha
- The sustainability of the culture: the sainfoin stays productive only two years.
- The harvestability because of the loss of leaf during the drying on the field.

We can estimate an annual production cost for sainfoin. All the costs are averaged on the two years of the culture.

	Sainfoin (2 years of culture)		Classic TG on superficial soil (3 years of culture)	
	Costs	Production	Costs	Production
Seeds	150	-	50	-
Chemical fertilizer	0	-	45	-
Mechanization	392	-	368	-
Soil preparation	*50*	-	33	-
Seeding	*18*	-	13	-
Supply of manure	*18*	-	18	-
Mowing and drying (3 cuts for a year)	*300*	-	300	-
Chemical destruction	*6*	-	4	-
Annual production	-	7 tDM/ha		6 tDM/ha
Production cost in €/tDM	77,4		77,2	

The reduction of fertilization allowed by the sainfoin is balanced by the high cost of seeds. The low perennity of this culture increase all of the fix costs (soil preparation and seeds for the main item). But the sainfoin also allows a higher productivity and a better quality of the forage.

The innovation do not allows a decrease of cost but a better use of low potential plots. The aim of the farmer is to replace the grasslands on superficial plots by an alternation between sainfoin and immature crops.

Perspectives and threats

In the future, the farmer will try to produce the seed of sainfoin himself to reduce the cost of the culture.

To continue in the reduction of input and to have a better price for his milk, the farm is now labelled as organic farm. The farmer has so a new objective of productivity of 6500 to 7000L of milk/cow/year.

He already produces enough of protein on his farm to reach this objective but continue to produce maize, to have a slowly digestible starch in the feeding.

The next step on pasture valorization is to change the breed of his herd, to pass from prim'holstein to a 3 ways crossbreed.

The limits of the adaptation to climate change seem to be the tolerance to the heat of the plants, but also of the animals. The adaptation of the old cowshed and the plantation of trees and hedgerows between paddocks looks like ways to investigated for the resilience of the system.

Legume species and grassland management, additional sheep breed and adaptation of a precision seeder to farm soils

Farm: **"Littarru Giancarlo"**
Location: **DOMUSNOVAS (SARDINIA) ITALY**

Background

Mr Littarru inherited his farm from his father. The farm (87 ha) is located in the South-West part of Sardinia (Italy). This sub-region is the most economically depressed area in Sardinia, so young people usual leave villages and emigrate abroad. Sheep breeding is one of the few job opportunities for people and the will of the farmer has always been to obtain a decent income for himself and his family. Unfortunately, several environmental and economic constraints greatly influence his farming activities. Farm soils are clayey, with sub-acid and acid pH, and suffer from waterlogging during the rainy season. The farmer can rely only on himself and on one seasonal worker also during periods of increased workload, because in the area there is a lack of agricultural seasonal workers. Finally, the farmer faces the unfavourable market for sheep milk.

Detailed description

To pursue his goals of higher income, the farmer decided to increase milk production, by breeding a more productive sheep breed, the Israelian Assaf sheep, in addition to the Sarda breed. He managed the two breeds separately, to make the most of the productive potential of the Assaf sheep (up to 430-480 l of milk per year), which have higher diet requirements than Sarda breed. For both breeds, he started to carry out the out-of-season mating to have milk production during summer, when regional milk prices rise. Moreover, the farmer introduced the cultivation of legumes, e.g. sulla, and the mixtures of clovers (*Trifolium subterraneum*) and sainfoin (*Ornithopus sativus*) with wheat or barley. In the mixtures with sainfoin, cereals were seeded at low seed rate. This strategy allowed the farmer to carry out soil tillage every two years. In fact, in the first year, both mixture component grew and sheep grazed. The grazing season stopped at the beginning of summer. With the first rains, serradella re-sprouted and could be grazed as a pure stand during the following autumn. The farmer adopted the same strategy for the first time also with sulla. Last year, due to the harsh drought during summer and autumn, both cultivations dried up and in the current year, the farmer did not repeated the cultivations and suspended out-of-season mating because he needed more time to family life to take care of his newborn son. Innovative crops will be re-established next year. Currently, he is cultivating:

- The complex mixture of T. michelianum, T. incarnatum, Lolium multiflorum, and L. multiflorum var. westervoldicum for grazing (10-15 ha),
- The simple mixture Lolium multiflorum – oat for hay production (35 ha), used especially in small paddocks for an easier management,
- And wheat, barley and oat in pure stands for grain and hay production (20 ha).

The soil tillage consists of shallow ripping, sod-breaking, and seeding+rolling carried out in a single passage. The farmers payed a particular attention to improve working conditions adopting strategies to reduce the time spent in agronomic practices. To do this, the farmer modified his precision seeder, so that it could be mounted in the frontal side of the tractor, while in the back side there is a heavy roller. In this way, he carried out seeding maintaining the roller always resting on the soil. Moreover, the seeder in the front of the tractor requires less power than a towed seeder, and this means saving fuel. The farmer fertilizes soils with diammonium phosphate before seeding pastures (150-200 kg/ha, for forage crops and cereals, respectively), incorporating the fertilisers in the soil during tillage and during pasture and cereals growth (140-160 kg ha-1 of ammonium nitrate). The farmer adopted a complex scheme of grazing management, based on paddocks of different sizes: 2 paddocks are 10 ha sized, 5 paddocks are 2.5 ha sized and 3 paddocks are 5 ha sized. The smaller paddocks are seeded with mixtures based on clovers and ryegrass (this mixture is easy to manage on small surfaces). Each of the smallest paddocks (2.5 ha) are grazed 6 times/month per 5 months, in average, in other words, each day sheep graze on a different small paddock. The wider paddocks are grazed daily, about 1-2 hours in the morning and 1-2 hours in the afternoon, for 5-20 days, depending on forage availability. After fertilisation, about 20 days are required to restore forage availability. Sheep diet is integrated with concentrates (brewers grains, beet pulp, soy flour) to boost milk production during summer, so that lactation in sheep is prolonged up to August (9 months instead of 6 months), also in absence of out-of-season lambing. Milk production is about 130,000-140,000 l per year, it is based on 360 heads of Sarda sheep, and 90 heads of Assaf breed. Milk is still being sold to dairies for cheese making.

Results

A higher income, an improved pasture production and quality and an improved life and work were the main results obtained from the adoption of mixtures based on serradella and sulla and the innovations concerning management. The introduction of legume-based mixtures allowed the farmer to increase the pasture availability and quality, an improved sheep health and lower costs for concentrates and lower use of fertilizer in the second year from establishment. The adoption of a second sheep breed with high productive performances allowed a higher yearly milk production and indirectly, a higher income, also if a higher workload was necessary when out-of-season lambing was carried out.

Adoption criteria

Other farmers can successfully introduce innovations of the Littarru farm. Concerning the breeding of the Assaf sheep, other farmers should be aware of the very different management of these breed compared to the Sarda sheep. In fact, dietary requirements of these sheep are higher than Sarda breed and if they are not met, milk production will be not different from Sarda sheep. Assaf sheep can be easily introduced also in other intensive or semi-extensive farming systems. The modification of the seeder is simple, and the combination with roller could allow farmers to save some fuel for seeding, because the needed for power is lower than other operational solutions. All agronomic situations where the use of heavy rollers are required could be suitable to the adoption of this innovation. The use of sulla or serradella mixtures is successful mainly to Mediterranean areas.

Future prospects

The farmer hopes to re-seed improve pastures based on sulla and serradella with the use of new varieties with higher drought tolerance. As alternative, he would like to have new species with similar features to seed. He would like also to use other fertilizer than the old diammonium phosphate, but the new fertilisers he tested are not efficient in the same way. Informal connections among farmers and the word of mouth could easily disseminate innovations to neighboring farmers.

Legume-based temporary grasslands and forage self-sufficiency

Farm: **'Santa Barbara', Porcu family**
Location: **loc. Santa Barbara (SARDINIA) ITALY**

Background of the innovation

The farm Santa Barbara has a long history. It belongs from over 50 years to the Porcu's family. It occupies an area of 78 ha, located in Nurra lowland (Sassari district). The whole farm is potentially under irrigation but usually only 30% is irrigated. The farm is devoted to sheep breeding of the 'Sarda' breed: 600 ewes, 110 replacement lambs and 15 rams. Currently, Bastianino (51 years old) manages the farm with his son Roberto (21 years old). The main farm production was and still is sheep milk, which is delivered to a farmers' cooperative producing mailnly Pecorino Romano PDO cheese. Starting from the early '80s, the market demand of Pecorino Romano underwent fluctuations and the market suffered from saturation. Consequently, sheep milk price started to drop. The farmer was forced to revise his farming system to stabilize and preserve his income. Prior to the milk price crisis, annual forage crops and winter cereals for grain production characterized the farming system, but the farmer bought on market hay and complements. Every year, the farmer carried out ploughing, fertilization and sowing, sustaining high costs for soil tillage and purchase of seeds and supplements. The farmer started to look for solutions to reduce costs and, possibly, to increase income. He decided to increase forage and hay self-sufficiency and to improve the quality of farm productions (milk). Thanks to the collaboration with consultants and technicians, he introduced pasture forage legumes and legume-based mixtures.

Detailed description of the innovation

The farmer introduced several forage legumes to increase the flexibility of his forage system. He sowed innovative mixtures based on annual self-reseeding pasture legumes and winter cereals. Currently, the diet of dry or pregnant ewes in Porcu farm is based on fresh forage grazed in temporary legume-based grasslands and pastures, supplemented with hay and small amounts of concentrates (sugar beetroot pulps). The diet of lactating ewes is based on fresh forage grazed on temporary grasslands, supplemented with lucerne hay (twice a day) and concentrates (usually corn, pea and barley), according to the needs. Temporary grasslands are represented by different kinds of grass-legume mixtures (Lolium multiflorum or/and a local ecotype of Hordeum vulgare, Trifolium alexandrinum or T. incarnatum or T. resupinatum) and have a flexible use. Annual forage crops are grazed during winter and mowed for hay production in late spring. Forage legumes (white clover, sulla, subclovers and annual medics) are grazed. White clover is grown under irrigation during summer. Grazing is limited in time in the summer period but it is free for the remaining time. Sulla stands are sown within the first decade of October. Sulla stands are exclusively grazed. In the first growth period, grazing is allowed for 2 hours per day at most, and then it is increased to a maximum of 4 hours. With this management, sulla temporary grassland lasts 2 years. Annual self-reseeding pasture legumes (subclovers and medics) are sown in mixture with cereals. Cereals are present in the mixture composition to guarantee the herbage production starting from the year of establishment (winter). The farmer limits the grazing duration in the first period after sowing to obtain a good seed establishment. During winter and early spring, the stocking rate is increased at a high level. Afterwards, the farmers stops grazing in order to allow the self-reseeding of subterranean clovers. The legume-based pastures persist for 2-3 years. These temporary grasslands are not mowed. Lucerne is the forage crops that is cultivated in the farm for hay production. Usually, it is cultivated under irrigation in summer and the meadow lasts for 4-5 years. Farmers use occasional irrigations also to guarantee the autumn establishment of the temporary grasslands, e.g. sulla and annual self-reseeding legumes, and the summer growth of forage crops, e.g. white clover and lucerne.

Results obtained from the innovation

Currently, the farm is fully self-sufficient in forage, hay and straw production. Similarly, up to 90% of the supplements used in the farm are self-produced, except for sugar beetroot pulp, pea and barley that are purchased on the market. The wider use of forage legumes and the lower levels of inputs i.e. fertilizers, ploughing, seeds sensibly reduced the production cost of milk and milk quality was improved, too. The farmer obtained a higher yearly forage production, thanks to the extended forage growing season (especially in early autumn and late spring) and an improved forage quality, if compared to previous annual forage crops based on the monoculture of cereals.

Adoption criteria of the innovation

Other farmers can successfully increase their forage self-sufficiency adopting the variety of temporary legume-based grasslands cultivated in the Porcu farm. In some cases, annual self-reseeding pasture species (subclovers and medics) in mixture with annual grasses and/or cereals could have a longer persistence than 3 years, especially if the appropriate grazing management and weed control are adopted, with positive effects on the farm cost reduction. The forage system adopted in the Porcu farm could be of great interest to farmers who carry out the out-of-season lambing in Mediterranean environments. In fact, for these farmers, the goal is to achieve regular sheep milk sales in the market throughout the year and higher milk remuneration during summer, but in normal conditions, they need to overcome the scarce availability of pastures during summer, at reasonable costs, at farm level.

Future prospects of the innovation development from the farmer point of view

The farmer would like to have the availability of new forage species to further extend seasonal forage availability in his farm. He thinks that a major role could be played by native forage species with improved forage production and drought tolerance. The farmer believes that use of the forage legumes could be boosted if more efficient and selective herbicides will be available to be used in the pure stands of temporary legumes, especially for Sulla. He would also appreciate the availability of devices for forage dry matter measurements to improve the management of pastures with rotational grazing.

Improving dairy sheep farm economic efficiency moving from semi-intensive to extensive farm management

Farm: **'Truvunittu'**
Location: **OSILO (SARDINIA) ITALY**

Background

Up to the early '80s, Mr. Pulinas profitably produced sheep milk that he sold to dairy factories. In fact, milk price was high and guaranteed a good income. Dairy factories used sheep milk to produce mainly Pecorino Romano PDO, an aged hard cheese used in blends with other cheese varieties as grated cheese and mostly marketed in America. Starting from 1982, the demand of Pecorino Romano underwent cycles of low and higher demand and the market suffered from saturation, due to the great amounts of cheese offered by dairy industries. Consequently, sheep milk price started to have high market volatility. The farmer income became extremely variable from year to year. The farmer was forced to revise his farming system to try to stabilize and preserve his income and plan investments. Until that moment, Mr. Pulinas had been adopting a semi-intensive livestock farming system. In his 85 ha farm, 20 ha were cultivated with cereals for grain production, 24 ha were seeded with annual forage crops for haymaking, 6 ha were cultivated with mays for silage production under irrigation, and 26 ha were covered by natural permanent pastures. Every year, he carried out ploughing, fertilization, sod breaking and sowing to harvest forage for sheep, sustaining high costs for soil tillage and purchase of seeds. Grasslands were managed with rotational grazing (few days). Sheep diet was integrated with concentrates and corn silage to boost milk production.

Detailed description

The farmer aimed at giving a chance of survival to his farm in a changing world by looking for solutions to reduce costs and, possibly, to increase income. He decided to increase the areas covered by permanent pastures in the farm, avoiding costs for annual soil tillage. Moreover, he stopped milk sales to dairy industries, built a farm mini-dairy to process its own milk into cheese, and started to sell his dairy products.

The first problem the farmer faced was how to increase of the area under permanent pastures, following the abandonment of intensive cropping of annual forages and concentrates (mais) and the annual soil tillage (plough). He decided to collaborate with researches to test new species and their mixtures that would meet his requirements. He sowed innovative mixtures based on local annual self-reseeding and perennial clovers and grasses (i.e. Lolium rigidum, Medicago polymorpha, Trifolium subterraneum, T. pretense).

The second problem to face was to how to enter into the market with his cheese. He studied the market of regional dairy products. He realized that the most interesting product he could offer in a saturated market was fresh ricotta cheese at the end of summer (September), when the offer of this product was negligible because most sheep were dry. For this reason, he started to carry out the out-of-season sheep mating to increase milk production during summer months. Later, he abandoned this practice and now, he is promoting summer milk production in a part of the flock that lamb in May–June.

Currently, he manages 53.5 ha of improved pastures established in different periods, 5.5 ha of natural permanent pastures, 2 ha of sulla and 15 ha of crops under annual rotation for haymaking (oat-Italian ryegrass in mixture followed by annual legumes). The farmer fertilizes soils with diammonium phosphate before seeding new pastures (200 kg/ha), incorporating the fertilisers in the soil during tillage and does not use fertilizers during pasture growth. In opposite, the farmer uses ammonium nitrate during crop growth of annual forage crops for haymaking, in addition to diammonium phosphate. Overseeding in permanent pastures is carried out, when necessary. Pastures are divided in 5-6 paddocks (4-7 ha each) used for lactating ewe. The rest of pastures is divided in small plots (1-1,5 ha) where sheep with lambs graze. The farmer uses daily pasture rotation in substitution of classic rotational grazing of paddocks because he observed an improved herbage production and quality and an improved weed control. Fresh forage is available all the year, excluding dry season (from June to September), when sheep graze on stubbles and high quality hay and concentrates integrate the diet. At the end of spring, the farmer cuts herbage still available in pastures, as well as after summer grazing. The farm is now fully self-sufficient in hay and straw production. The farmer purchases small amounts of corn flour, soy flour, soybean hulls and fava bean to integrate sheep diet during lactation.

He processes in his mini-dairy about 80,000 l of milk per year. The farmer sells his cheese and fresh ricotta cheese both on farm and in his shops, which he opened in a nearby town and in a touristic village in North Sardinia. He also supplies small-specialized shops in high quality products in the chief-town and neighboring villages and is starting a web commerce.

The farmer also joined the initiative “Adotta una pecora” (Adopt a sheep), suggested by one of his friends, a shepherd, to look for economic help of sensitive and caring people to environmental and cultural problems to the pastoral world. In change of a fix sum of money, the farmer offers certified organic products directly, avoiding costly and unnecessary steps, guaranteeing the consumer even the possibility of a direct control of production.

Results

The farmer workload increased due to the on-farm cheese-making, and he involved in farm activities his son Giuliano and a seasonal worker. Nonetheless, his income increased to a notable extent, thanks to the high consumers’ demand and higher price of dairy products sold at the end of summer. The wider use of permanent pastures and the lower levels of inputs sensibly reduced the production cost of milk. Milk quality and cheese yield per liter was improved, too. The farmer obtained also a higher yearly forage production, thanks to the extended forage growing season and forage availability of permanent pastures (especially in early autumn and late spring), if compared to annual forage crops.

Adoption criteria

Other farmers can successfully adopt improved permanent pastures if some micro-climatic features are met in their farms. The innovative farm is located in the slopes of a hilly site, and it is characterized by fresh soils, high-size soil seed bank and good organic matter content facilitate the establishment of long-term grasslands. The farm proximity to chief-town and other villages is a condition that make easy commercial exchanges and product selling.

Future prospects

The farmer thinks that permanent pastures can be further improved if future research on native forage species will be carried out. To further extend seasonal forage availability, he especially hopes for native forage species with improved forage production and drought tolerance. He would appreciate also the availability of devices for forage dry matter measurements to improve the use of pastures in paddocks. Informal connections among farmers and the word of mouth could easily disseminate the innovation to neighboring farmers, but the advantages of the use of improved permanent pastures on farmer income and animal production should be disseminated more efficiently by extension services. Unfortunately, extension services are not working properly in all Italian regions. The threats come from the unfair competition of foreign low-price dairy products, if consumers are not sufficiently sensitized to environmental and cultural problems to the national pastoral sector. Another critical point concerning the farm management concerns the direct selling. Farmers are often not good sellers and do not have sufficient marketing skills.

Improving dairy sheep farm economic efficiency by organic fertilisation, using conservative soil tillage and producing and directly selling cheese

Farm: **'Fratelli Saba'**
Location: **loc. SACCHEDDU (SARDINIA) ITALY**


Background

The farm 'Fratelli Saba' belongs to the Saba family from decades. Their grandfather cultivated annual forage crops, vegetables and grain legumes that he sold in the national market together and produced a special cheese ('casu batteria'), to be eaten with fresh faba beans. He bought the first milking machine of the farm in 1968. After the retirement of their grandfather, the farm management was entrusted to a sharecropper. The on-farm cheese making was stopped and milk was sold to dairy industries. In 2004, the Saba brothers signed the agreement of a loan for use with their father and started to manage the farm by themselves. They soon realized that the income obtained by milk selling was not high enough to cover their innovation needs and external manpower. The young brothers decided to start to produce cheese on farm and to increase forage production and the agronomic efficiency of management. Until that moment, annual forage crops were prevailingly cultivated in the farm. Ploughing was performed every year, nearly in most of the farm surface.

Detailed description

The farmers looked for strategies that aimed both at reducing production costs and at stabilizing income. In fact, they aimed at innovating farm structures and machinery and needed to rely on a reliable annual income to amortize costs among years. Currently, the flock management relies on pastures, which cover 130 ha out 180 ha of the farm. The rest of the farm is cultivated with cereals for grain production (30 ha) to feed sheep, permanent crops (olive orchard) and permanent grasses to produce roll-out grass lawn. Grazing takes place also under olive trees.

In pastures, they use mixtures based on grasses and cereals composed by L. multiflorum (30-35%%), oat (20%), barley (20%), triticale (20%), rye (5%), in annual rotation with mixtures based on clovers, i.e. T. squarrosum, T. alexandrinum, T. incarnatum (90%) and 10% of seeds of L. multiflorum. Other pastures are based on a mixture of cichory (70%) and T. alexandrinum (30%). Finally, lucerne monoculture is cultivated to produce hay, which yield is sufficient to meet all diet requirements of sheep within the year.

Plough is no more carried out, in fact minimum tillage is usually carried out. This allowed farmers to improve soil conditions, reduce soil erosion, and save fuel to reduce costs. A further reduction of costs come from the adoption of organic fertilization, with the use of civil sewage sludge. This practice is carried out under the control of a public administration, which has in charge the soil analyses before the fertilisation, the chemical and microbiological analysis of sewage sludge, the calculation of the proper amounts to be distributed, its distribution in soils and its incorporation into soil, at least in the first year. In average, 80 kg of nitrogen and 16 kg of phosphorous per year are incorporated into the soil. The operation has no cost for the farmer, except for the incorporation of the proper amounts of sewage sludge in the following two years. In lucerne stands, sod-seeding is carried out at the beginning of autumn with Italian ryegrass, when lucerne is already dormant. In this way, Italian ryegrass can take advantage of the nitrogen fixation from lucerne and fresh pastures are available early, allowing soil cover in winter. At the same time, the lucerne production for haymaking is not influenced by Italian ryegrass crop. The management of pastures follows a rotational scheme, and sheep graze for few days (2-4) in each paddock. Pastures are divided into 30 or more paddocks, ranging from 2 to 17 ha, used for lactating ewes.

Grazing is time-managed: ewes graze for about two hours per day, and then concentrates and integrators meet the rest of their diet requirements. The flock consists of 1270 heads, of which 1000 are lactating sheep. Milk production ranges between 240,000 and 270,000 l per year. It is entirely processed on farm. To maximize milk production, at the end of the colostrum production, lambs are artificially fed with powdered milk. Dairy products are seasoned cheese (4-5 types, depending on the season) and ricotta cheese. Farmers sell their products following the farm-to-fork approach in their own shop in the nearby town and in fairs and local street markets.

Results

The farmers needed to recruit workforce for the management of farm activities (4 full time workers), among them a specialized cheesemaker, and to invest money to improve farm buildings and machinery, but they are repaid by the market success of their products and the increased farm income. Currently, they receive more requests for cheese than what is available. The high care of animal diet allow farmers to obtain a high quality milk and high cheese yield per liter. The continuous control of production cost is a winner strategy to improve their total revenue.

Adoption criteria

Innovations in this farm can be adopted by farmers who aims at having an income independent from market fluctuations of milk price. The measures adopted to reduce production costs are easily reproducible, especially the adoption of sod-seeding, the oversowing of Italian ryegrass on lucerne stands and the organic fertilisation.

Future prospects

The farmers thinks that further improvements of their farm can come only after improving their labour conditions. Currently, this is the most critical point concerning the farm management.

Grassland management on upland moor

Improving feed efficiency

Farm: **Georg und Jan-Niklas Alter**
Location: **Elsfleth, Germany**

Background

Georg and Jan-Niklas Alter´s farm is a dairy farm located in Elsfleth in Northern Germany. It is a family-owned farm with 140 dairy cows of high genetic merit. The farm is located in a permanent grassland region, that is characterized by the difficult soil type “upland moor”. Upland moor is a soil type with high carbon content, a very low yield potential and a high moisture content. During the summer the soil can dry out very fast. With a consequent grassland management, it has been possible to achieve a good yield potential of the sward after taking over the farm 45 years ago. The land was a natural reserve and has been extensively used before. Nowadays, the farm manages about 137 ha of permanent grassland as grazing and silage ground. Besides, the consequent grassland management Georg Alter focused on breeding to find the suitable cow for the system and the difficult land.

In the beginning Georg Alter was looking for a good technique to overseed the paddocks. The local contractor used a combination of a harrow and a seeder, but the germination rate of the grass was not satisfactorily for the farmer. Another contractor bought a new slots-seeder technique, which worked and achieved the desired result. Georg Alter bought finally the technique from the contractor, because of a low demand.

Further, the Chamber of Agriculture in Lower Saxony conducted several field trials on the farm to test the yield potential of different grass types and mixtures on upland moor. The experiments have shown that without sward maintenance the yield potential and the sward condition are decreasing dramatically after three years. The results proved that grassland on upland moor needs good management and regularly overseeding with new grass genetic.

Detailed description

Georg and Jan-Niklas´ grassland management pays off in high grass and milk yield, good health and a high feed efficiency. An intensive pasture/cutting rotation is practiced on the farm. About 137 ha of agricultural land were cut three to four times a year and between the cuts about 130 ha were grazed. Some paddocks were only grazed and the rotation starts in the end of April. The other paddocks were cut in May and grazed hereafter. Rotational grazing suits to the cutting/grazing rotation and the paddocks are grazed out well and the average yield of the paddocks is 10-12 t TM/ha, which is comparable high for the region. The paddock size is in average 3,5 ha and each paddock is grazed for approx. two to three days.

Due to the intensive pasture/cutting system, the paddocks are fertilised with slurry and with calcium ammonium nitrate (CAS). The first slurry application of 10 to 12 m³ will take place in March or as soon as the conditions allow it. Heavy rolling of the paddocks is necessary, because the upland moor can raise and shrunk due to temperature differences. Further, a harrow opens the sward and removes undesired grass types. A combination of a harrow and a seeder was displaced by a slot-seeder technique, because the seeds remain in the grass and do not have direct soil contact. The slot-seeder is used after the first cut under dry conditions, it places the seeds in 2 cm depth. The working width is only 2,5 m, which causes in high labor input for overseeding (1 ha/hour). Within three to four years every paddock is overseeded with new grass genetic. Alter farm always choose new grass varieties to improve the sward quality.

Results

The consequent grassland management on upland moor increased the feed efficiency on the farm. Grass is the basic feed on the farm and a great focus on sward quality and good silage results in a high production of 5000 to 5500 kg/milk/year/cow only from grass. During the summer the cows only get fresh grass on pasture and have access to hay. In winter and when it is not possible to graze, the cows get good quality grass silage. Concentrates are fed in the milking parlour and the amount depends on the cow´s milk yield. The cows have an average a milk production of 10,000 to 11,000 kg milk per year.

The milk production per kg basic feed increased over the last year. In addition to an excellent grassland management, the cows genetic improved as well. The farmers select healthy dairy cows with a high basic feed intake capacity, good grazing ability and a good feed efficiency. Many farmers and discussion groups visit the Alter farm to learn from their experience and their grassland management on difficult land. The land conditions are very difficult regarding low pH, low soil fertility and a low yield potential. Moreover, in spring and in autumn the land is too wet to drive or to use, which makes it impossible to expand the grazing period. Because of this the intensive focus on the sward is necessary and probably the key for a good production.

Adoption criteria

To adopt the system of the Alter farm you need to stay patient to see results, says Georg Alter. At the first view it seems like that the management is too costly and the labor input is too high. But the effort of constantly reseeding and overseeding is indispensable to achieve good yields on upland moor. Also, the investment into new machineries can pays off after some years. An own seeder can be useful in case of flexibility. The farmers are convinced about that the process of changing an established working step begins with mind-setting. An open-minded and sometimes a critical view on these established working steps can bring the farmer to new solutions.
Further, the farmers should spend money by choosing the right grass variety. Grass is the basis of a well-performing pasture and cutting system and new varieties improve the yield potential in general.

Future prospects

In future sharper fertilizer regulations will be the greatest challenge for the permanent grassland region. Especially on soils with high organic matter content the amount of nitrogen is limited. In order to this it will be challenging to realise the full yield potential of the grassland. A low fertilizer level will decrease the percentage of the desired grass types as English Ryegrass. Due to the soil conditions it is already difficult to maintain these grass types, but it will be even harder under more extensive conditions.

The farm invests in a trailing-shoe for the slurry trailer in the last years and increased the fertilizer efficiency. The farmers know that they need to put a stronger focus on fertilizer efficiency and other climate relevant topics.

Public relation work

Farm channel "My KuhTube"

Farm: **"Amos Venema farm"**
Location: **Jemgum (Ostfriesland), Germany**

Photo: NDR

Background

Amos Venema´s farm is a dairy farm located in Ostfriesland in Northern Germany above 2 Meter sea level. It is a family-owned farm with 171 dairy cows located in a grassland region. About 56 ha of farm land is in a bird reserve and approx. 35 ha of grassland is in a water conservation reserve. The restrictions of the nature reserve challenge the grassland management due to a restricted grazing period, defined cutting dates and the presence of geese, who decline the grass yield of the first and second cut. After Amos came back from an Australia trip and he was passioned about to show his daily work to the public. At Australian farms it is common to have webcams inside the shed for animal control and to provide the opportunity of following the live broadcast from the shed to the public. Amos created different ideas how to connect town people with the daily farm life. One of his ideas was to generate a version of the international TV-show "Big Brother" on his farm. The contestants live on the farm and do the daily work. The contestants should experience the real farm life aside the idyllic farm expectations. However, there is no insurance that accepts no liability, so it was not feasible.

Due to communication barriers between the urban and rural population Amos and the region's dairy industry association (Landesvereinigung der Milchwirtschaft Niedersachsen e.V.) developed a video channel on YouTube. "My KuhTube" shows twice a week farm videos made by one of 18 dairy farmers, who are involved in the project. The videos are about their daily work and interesting farming topics. The main aim of “My KuhTube” is to strengthen the relationship between farmers and consumers, to inform the consumers about modern dairy farming and to give them an authentic understanding of the daily work on farm and about the farmer.

Detailed description

Amos Venema started in 2013 with making videos about his work on the family farm for the YouTube channel “My KuhTube”. He is seen as a pioneer for agricultural public relation in Germany and embodies and represents the farmers. Besides the videos, he opens his farm gates for visitors and holds presentations on different events. Amos is passionate about informing people about his profession and his vision is to send positive and realistic messages to the public. In Amos point of view are daily positive messages from farmers more successful than an open-farm day once a year. The “My KuhTube” videos are uploaded twice a week and the consumer have the possibility to accompany the farmer´s everyday life. The farmer gets an identity and the distance between consumer and farmer can be overcome.

In the beginning of the project each farm, who is participating got a video equipment from the region's dairy industry association (Landesvereinigung der Milchwirtschaft Niedersachsen e.V.). A media law contract safeguards every farm, who is making videos for the channel. In addition, every “My KuhTube”- farm has participated at the milk award of the region's dairy industry association (Landesvereinigung der Milchwirtschaft Niedersachsen e.V.) and has been checked in advance.
The videos are uploaded on www.mykuhtube.de and a short portrait of each farmer is shown on the webpage to personalize with the farmer. The videos topics are chosen by the farmers themselves. Amos made videos about the cow release in spring, the milking machine, silage making, cows on grass or the milk market in general. To ensure medial security for the farmers every video raw material is professionally edited.

Results

The video channel “My KuhTube” exists since 2013 and more farmers has followed and make videos for the channel or have been motivated to agricultural PR work. The project “My KuhTube” was a door-opener for more PR projects. “Dialog Milch” and many TV and radio interviews followed due to a successful implementation and an increasing interest from the public. The “My KuhTube”-farmers are known in Germany and receive a lot of feedback. Besides the positive feedback they also get negative feedback. Their statements are spread quickly and the need to get used to stand in public. In general, acceptance of farmers in public has been improved and consumers and farmers engaged more often in dialogue. Consumers are interested in the daily work on a farm and online blogs have a great demand and positive feedback. Amos noticed that more trainee and students request for a farm internship on his farm, but there is still a long way to go to provide a realistic picture about modern farming.

Adoption criteria

To generate a similar concept of sharing agricultural knowledge to public it is important to understand that a PR project do not need to reach every person. It is already efficient to reach a few persons, who spread the word in their personal environment. Further, it is necessary to ensure security for the farmer´s videos (media law contract, professional filtering of the videos). It is easier to start a project together with an association, who manage and spread the videos. Every small and realistic agricultural PR is important for the profession.

Future prospects

In future the farmer would like to implement a permanent agricultural TV channel and hope that more farmers have the courage to invest time in PR work. Further, it is essential that the farmers keep up with the times and are open-minded for new communication ways with the consumer.

Grasbased system (No inputs)

Bernd Achgelis

Farm: **"Bernd Achgelis"**
Location: **Stadtland (Wesermarsch), Germany**

Background of the innovation:

What was the context?

The farm is located in the middle of the Wesermarsch region, in an intensive dairy cattle region with strong competition on the land. The high liabilities at the time when the farm was handed over to the son forced the son to look for alternatives in order to reduce his liabilities. There were some discussions with banks and consultants about an extension of the stable building with a new milking system to ensure the most efficient and thus liquidity in the next few years. As this project was very labour-intensive and risky, other financial possibilities were calculated, including a conversion to organic farming with suckler cows and little external input (feed, fertiliser). The farmer liked this option because of the ethical principles, labour savings and the old liabilities could also be repaid.

What was the problem to solve?

The liabilities from the past should be paid and if possible, no new ones should be taken up. Costs were to be reduced, animal welfare increased, and the risk minimised.

What were the farmers' motivations?

Ethical, ecological and personal reasons were responsible for the motivation.

Cows and Calves on pasture 1.

Detailed description of the innovation:

What did the farmer do?

In the conversion phase, the old milking system was first abolished, the cows were no longer milked and the calves remained with the cows. It was crossed in with a limousine and Angus, the old stables were converted into straw stables and scattered with their own hay. The feeding was converted to complete grassland in the form of pasture and hay and no external carriers were used.

Results obtained from the innovation:

What has been improved (workload, profitability, higher production,…) and to what extent?

The workload was reduced by one work unit so that the farmer himself could pursue an external profession and the woman remained the main person responsible on the farm. The subsidies and the sale of cattle after about 9 months were used to repay liabilities and cover staff costs. The cows improved their health considerably and veterinary costs were reduced. Wear on machinery was also reduced.

Adoption criteria of the innovation:

In which context and at which condition the innovation can be adopted by other farmers?

The innovation is based on an alternative solution to get out of the growth spiral in order to concentrate on one's own resources and move as self-sufficiently as possible. Farmers with similar structures should not only deal with the growth issue, but also look for healthy solutions for the use of existing resources. Furthermore, the weight gain of animals without external feed based on grassland is comparable to other systems and should therefore be considered.

Future prospects of the innovation development from the farmer point of view:

What can still be improved?

The pasture management could be even more effective and thus a rest on the pasture could be avoided. The preparation of the hay mist for the perfect swelling of the soil (humus formation = increase in yield) An appropriate price for the animals from such systems cannot be guaranteed via conventional slaughterhouses. Direct marketing would require more personnel and is not possible at this stage with the available resources. A concept of direct marketing via social media and website with farm slaughtering exists but is not yet feasible.

How can it be disseminated?

The farmer is happy to receive farmers and introduce his system and reminds them of the use of their own resources and the dependence of today's agricultural fodder farms on the market. Its innovation has ethical, financial and operational backgrounds. Farms with the same conditions can meet for discussions on the farm.

What are the threats?

The system is very weather-dependent and due to the future strong fluctuations of the weather it is necessary to prepare for these events and to calculate buffers of hay bales. Another challenge is the increasing competition of the land prices and the pressure on the land.

Cow and calves on pasture 2.

Water Level

Farm: **"Holthusen farm"**
Location: **Brake, Wesermarsch_Germany**

Farm: **Heiko and Heike Holthusen**
Location: **Brake, Germany**

Background

The innovation was implemented in context of the project SWAMPS, which aims at developing and evaluating practicable options for actions on how to reduce greenhouse gas emissions on grasslands which are intensively agriculture and typical for Lower Saxony, Germany.
The focus is on the involvement of local actors, in particular farmers and responsible persons from the water and soil associations, in order to promote insight into the necessity, to develop practical and regionally optimised solutions and measures for climate-friendly agriculture to obtain multipliers for the implementation of outside the project area.

The connections between global climate change and the primarily responsible greenhouse gases carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) have been largely researched. The conversion processes in the carbon and nitrogen cycle associated with agricultural production inevitably lead to such greenhouse gas emissions.

The Kyoto Protocol stipulates that anthropogenic greenhouse gas emissions are to be reported using internationally agreed methods (National Inventory Report (NIR)). Emissions from agricultural land are reported in the "Agriculture" and "Land use, land use change and forestry" sectors. In this context, other emissions of N2O from fertilisation and of CH4 from livestock farming are primarily attributed to the "agriculture" sector. CO2 emissions from drained bogs or grassland upheaval are reported in the "Land use" sector. Currently, the EU-wide share of greenhouse gas emissions from the agricultural sector amounts to approx. 10%. In Lower Saxony, the share of greenhouse gas emissions from the agricultural and land use sectors alone amounts to approx. 28%, a significant proportion of which comes from moorland use and grassland upheaval. Due to the large proportion of moorland in Lower Saxony (38% of the total German bog area) and the predominantly intensive agricultural use of these moors, this area is of particular importance.

Due to the high basic moisture content, well over 80% of the agricultural area on the moor sites in Lower Saxony is used as permanent grassland. In this context, the protection of grassland on bog soils is generally also a climate protection measure, because the conversion of grassland into arable land leads to higher CO2 and N2O emissions solely due to the necessary increased drainage and the associated more intensive cultivation.

While numerous research projects have dealt with the effects of grassland upheaval on CO2 emissions from mineral soils, corresponding figures for moor sites are almost completely lacking. Nor are we aware of the climatic impacts of different grassland replenishment practices used by agriculture to ensure productivity and forage quality of grassland. Also, not yet known are the nutrient inputs coupled to the various utilisation and water level variants, in particular nitrate, phosphorus and iron, from the soil to adjacent waters.

A site-adapted grassland management on bog sites offers enormous potential for reducing CO2 emissions.

[to be completed by Jendrik] The innovation is that water management system has been implemented in two test sites, making it possible to manage the water level in ditches as well as in the grassland. For raining the water level in the test field, additionally a drainage system was installed enabling a better water flux in the ground. The main motivation with these installations is to reduce the greenhouse gas emissions from grasslands on bog or fen areas.

Detailed description

The coordinator of the SWAMPS project was responsible for the installation of the water management and drainage system. The farmer makes is land available for testing the higher water levels. In addition, he is managing and testing the higher water levels in close cooperation with the responsible project partners analyses the practicability of the measures.

Results

What has been improved (workload, profitability, higher production,…) and to what extent?

So far, the testing of the implemented measures is just preliminary not allowing any reliable statements from previous measurements to be made. Additional measuring and calculation within the two year will show if the assumptions about the measures taken are correct.

Adoption criteria

If the testing of the water management will be successful, it has to be considered and planned how such an innovation can be implemented in larger scale and also other bog areas involving the farmers and other stakeholders in the planning.

Future prospects

The first project year showed that the correct implementation of the water management is essential. Several parameters and the topography of the area have to be considered. For practical solutions the cooperation with the water and soils associations is one of the most important starting points for these measures. The distances of the drains, but also the place and size of barrages will have to be carefully planned.

In view of the management of the grasslands, the farmer will have to adapt the mowing cycles to the water level of his fields.

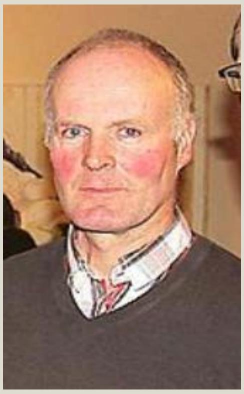
The innovation can be disseminated through open farm days, farm walks, targeted workshops and conferences.

The costs for the implementation of the water management measures might be too expensive. And also the reduction of the greenhouse gas emissions might be lower than anticipated.

Herd-screening tool

"Data collection allows more effective selection resulting in successful breeding"

Farm: Cord und Ina von Runnen GbR
Location: Oldenbrok, Lower Saxony, Germany



Photos: NWZ online and Masterrind

Background

Cord von Runnen `s farm is a dairy farm which is specialised in organic farming since two years. It is a family-owned farm with 170 dairy cows located in a grassland region with temperate oceanic climate. The conversion to organic farming has given Cord von Runnen a number of new challenges and conditions. Herd typing was a valuable instrument for him to adapt the herd to his new conditions. The herd typing allows an individual mating with an automatic adjustment advice for his breeding index. This means that he is able to make site-specific mating if we highlight the right characteristics for his HF grazing cows. His target was to use the heterosis effect by using crossbreeds in the breeding line.

On his farm selected animals are genomically tested and the data are stored in a digital management system. Cord von Runnen sets specific breeding goals for his individual challenges and circumstances and thus creates his own breeding index (ecological). The genomically tested animals are divided into categories with the help of its breeding index and later proposals for mating are made automatically. The main task is therefore to determine the breeding objectives, which can certainly vary but provide an enormous potential for the specific use of cow genetics. Cord von Runnen has the chance to make future management decisions based on the genomic data determined for his female animals.

Detailed description

Cord von Runnen was highly motivated to improve the health of his herd. He decided to implement the innovation because it offers the opportunity to improve the breeding of dairy cattle herds and thus the health of his herd. Genomic breeding values are determined for all young females (up to and including the first calves) and health and claw data are recorded. The used program *Netrind Genom* provides by Masterrind provides all important information for a complete evaluation of his animals online at any time. In addition, various evaluation tools are used to check the status and development of his herd and the tools make it possible to compare data with other farms. The innovation includes an even better bull selection based on the safe genomic breeding values of the examined female animals. Cord von Runnen focus especially on hornlessness, hoof health, overall fitness, milk volume and udder health.

Results

With the help of herd typing and consulting, a suitable breeding index could be created for Cord von Runnens farm. The genomic testing enabled the adaptation to local conditions and the von Runnen`s farm characteristics. Especially udder health was improved as well as the cow´s´hoof health.

Adoption criteria

To achieve an adequate level of the genetic progress requires the support of specific expertise. According to this, von Runnen farm has an advisor expert from a breeding cooperative called Masterrind. Since the program is offered by Masterrind it is therefore accessible to everyone. Each farm can create its own breeding index and meet its challenges through personal evaluation of data.

By this, the foundation has been laid for a future establishment of new, economically important traits in the area of fertility and cow health and vitality on this farm.

Future prospects

The next steps will further strengthen autonomy with regard to using genetics in order to control the progress of the farms breed. The criteria of innovation can be adopted by any farmer willing to invest in genetics and farm specialization, namely, to record animal performances and to use the enormous potential of using cow genetics. What has to be considered is that after implementing a genomic breeding value estimation there are still challenges to be faced.

The incorporation and usage of health data as additional information for selection will be taken into account. The goal is to increase the benefits for farmers without knowledge in terms of breeding so that implementation will be facilitated. Another target will be to lower the costs for testing since the costs inhibit the demand from famers willing to improve their herds genetic.

Short sward grazing and combination between barn-drying of hay, dehumidifier and photovoltaic plant:

"Sustainable production with few external imports and reduction of working time"

Farm: **Baumannhof**
Location: **Toblach/Dobbiaco (South Tyrol), ITALY**

Background

The joy of trying out new ideas, the constant search for optimisation and the high motivation of the farmer were the decisive factors for the step-by-step developments on the 15-ha large dairy farm. The collaboration with the local extension service for mountain farmers (Bergbauernberatung Südtirol) was helpful for the planning and development of the ideas.

The farm's innovation cannot simply be fixed at a single point, but results from the interaction of several sub-innovations that enable more cost-effective production and improved working conditions. The need to reduce working time arises in particular from the fact that the farm is purely a family business where the farmer and his wife work full-time.

Detailed description

The first important step in restructuring the farm was the new construction of the stable and the barn. The concept of the building was developed by the farmer himself and then built with a high amount of own labour. The animals' welfare was the most important factor in the subdivision and furnishing of the stable. Animal-friendly materials were chosen and so, for example, the floor was fitted with rubber mats and the cubicles were made of wood.

The unheated stable ensures a high degree of light and fresh air for the animals, which is complemented by the outdoor paddock. In addition, a ventilation system was integrated, which works without external energy. This is possible by using the energy of the photovoltaic system and the warm air rising at the high rear wall of the stable. A new approach was chosen for the method of manure removal in order to ensure trouble-free operation even at sub-zero temperatures. The manure is removed directly into the pit without the slurry being first fed into the transverse channel and then further into the pit. On cold winter days, the heat from the slurry is used additionally as underfloor heating for the animals in the stable.

The appropriate orientation and inclination of the roof enable an efficient energy production through the photovoltaic system. In addition, the hay drying system works very efficiently in terms of energy consumption and drying capacity. This is made possible by the optimised design of ventilation performance, ducts and dehumidifier.

Another important step was the conversion to a grazing management. Originally, the farm operated an intensive silage feeding system with year-round indoor housing. Now, however, no silage is fed. The dairy cattle are kept using the short sward grazing system (German: Kurzrasenweide) in such a way that the use of concentrates is low and the purchase of external feed is hardly necessary. If the ground is dry enough in spring (mid- to end-March), the animals are allowed to go out on the pastures, even if there is no visible grass growth yet. This prepares the animals for the subsequent diet change. During the entire vegetation period, the animals graze eight hours a day on the pasture and remain in the stable only from end-October on. This requires breeds suitable for grazing, which can cover the energy requirements from herbage. Braunvieh and Jersey are kept and a breeding selection towards grazing suitability and efficiency in the use of roughage is performed. The young animals with a minimum age of six months are sent during the summer months for about 95 days to the summer pastures. In winter, the animals are supplied with the farm's own high-quality hay. The high roughage quality combined with reduced forage production costs is guaranteed by the well-functioning drying system in combination with a dehumidifier and photovoltaic modules.

Advantages

As a result of the introduction of the short sward grazing system (German: Kurzrasenweide), costs are reduced both for the supply of forage and for the mechanisation of harvesting and fertilization. Fuel costs are reduced as well. In addition, agricultural work is facilitated and the working time management optimised. The adaptation and simplification of work processes results in good living conditions for humans and animals.

In January 2018, after a six-month conversion, organic certification took place. The reduced conversion period for organic farming was possible due to the previous participation in agri-environmental schemes. Another important point is the production of haymilk with higher milk prices. Haymilk producers do not use silage and only hay is fed in combination with grazing. Per cow and lactation, 7,500 kg of milk are obtained. Every year, about 100,000 kg of milk are being delivered to the local cooperative dairy. The remaining milk amount is being used for feeding calves and the farm's own requirements.

There is no off-farm purchase of fertilisers and only the farm's slurry is used. However, the haymilk production causes difficulties with the fertilization, as the guidelines require a waiting period of 21 days from the fertilizer application to the next herbage use, which in the intensive short sward grazing system would occur earlier.

The introduction of the sub-innovations has reduced labour costs and enhanced net profit. Animal welfare was improved and expenses were greatly reduced. For example, the concentrates requirement has been reduced from 2,000 kg to 700 kg per cow and year, and consumption will be further decreased prospectively. In terms of hygiene and ingredients, the farm has always been among the top five farms delivering to the local cooperative dairy in recent years. This high milk quality is rewarded by the cooperative through a higher payment for the delivered milk and currently comes to 0.64 €/l. At the moment, however, the milk quality is not fully acknowledged, as the local dairy does not yet have an organic production line. In addition, organic concentrates are more expensive than conventional ones. However, the organic production is acknowledged by the payments for organic farming. Due to the constant search for optimization, the farmer has some goals and ideas for the future. According to the farmer, there is always room for improvements.

From a structural point of view, however, he is very satisfied with his farm. Therefore, the ideas for the future relate more to the operating procedure and in particular to the marketing of the products.

Adoption criteria

If a farm wants to implement the short sward grazing system (German: Kurzrasenweide), it requires sufficient pastures close to the farm and breeds suitable for grazing, which can cover their energy requirement mainly with herbage and roughage. In addition, technical competence is necessary, as grassland must be constantly monitored and the farmer must quickly react to changing weather conditions. With regard to the farmer himself, willingness to rethink work processes on the one hand and readiness to solve problems in unusual schemes on the other hand are required. It is important to break new ground and to think unconventionally. In addition, one must be prepared to receive criticism from the working and social environment. After all, if you go down so many unconventional paths and succeed, you can be sure of being considered a rebel and an outsider.

Future prospects

Due to the constant search for optimization, the farmer has some goals and ideas for the future. According to the farmer, there is always room for improvements. From a structural point of view, however, he is very satisfied with his farm. Therefore, the ideas for the future relate more to the operating procedure and in particular to the marketing of the products.

In the future, the farmer would like to keep all calves on his own farm. The male animals should be kept up to an age of 11 months. Then, if possible, their organically produced meat should be marketed under the 'Bio*Beef' label.

In addition, the farmer is constantly seeking to obtain a product in the dairy sector that is not easily replaceable with other products. Milk and in future perhaps also milk products shall be produced with the highest quality standards. In addition, an entry into direct marketing is being considered. This tendency towards direct marketing is particularly due to the above-mentioned fact that the organic haymilk is currently compensated only as conventional haymilk. The guided tours on the farm will be extended and an even stronger synergy with the concept of Farm Holidays should take place. In the future, the farm will be developed even more into a demonstration farm.

These last points correspond well with the farmer's more distant goal of closing the cycle of production and sale. This means that the farmer wants to produce milk products himself and then sell them at the farm to the visitors of the farm.

Short sward grazing and production of organic haymilk:

"Reduction of concentrates and extensive milk production"

Farm: **Professional School for Agriculture and Home Economics Salern**
Location: **Vahrn/Varna (South Tyrol), ITALY**

Background

Although grassland farming in South Tyrol is mainly limited to mountain areas and farms are often small, the intensity with which farmers run their dairy farms is often very high. The high milk yield per cow is achieved by means of a high animal load in terms of livestock units per hectare and an indoor feeding system with large use of concentrates. The organic farm is part of the Professional School for Agriculture and Home Economics Salern and is owned by the Autonomous Province of Bozen/ Bolzano. As a farm belonging to an agricultural school, the farm fulfils a didactic function too. For this reason, sustainable management is a pivotal issue, as the farm should serve as a model for the future farmers' generation. All employees are aware of their role as trainers of the 'farmers of the future' and accordingly try to take on a pioneering role in the way they operate, even if this is often skeptically and critically viewed by other farmers. For sustainability, it was important to extensify the originally intensive milk production on the farm. In 2005, the first step was therefore to switch from conventional to organic farming. The integration of grazing into the farm's workflow was primarily intended to improve animal welfare. A further extensification is aimed at by the farm. Therefore, in the last years, the amount of given concentrates was continuously reduced. By now, only 450 kg of a grain mixture is fed per cow and lactation, whereby this quantity is to be further reduced in the coming years. Moreover, haymilk is produced without feeding any silage.

This reduction in the concentrates use is an important concern for the educational farm for both economic and, in particular, ethical-ecological reasons. In developing countries, no arable land should be wasted on the cultivation of animal feed which would actually be suitable for the cultivation of human food and thus for nourishing the local inhabitants. Moreover, the reduction in the concentrates use results in a greater independence from the forage market and its price fluctuations.

Detailed description

As part of the conversion to organic farming, the stable was first rebuilt and a loose housing for the dairy cows was established instead of the tie-stall. Then, the pasture was integrated into the farm's operations. Currently, a combination of mowing and short sward grazing (German: Kurzrasenweide) is used. However, the whole pasture area is not available constantly to the animals, but it is divided into paddocks. This is mainly necessary because a public road running through the grassland areas of the farm does not allow for a free movement of the animals.

In spring, the animals are first given access to the largest uninterrupted grazing area close to the farm. As soon as the grass growth rate rapidly increases, about half of the area close to the farm is divided into four paddocks. The animals remain on each paddock for two days and move then to the next one. This results in a rest period of six to seven days for the grazed area before it is grazed again. At the same time, the second half of the grassland area is not grazed and mown instead for hay production. After one and a half months, the herd is moved to these areas and the regrowth is grazed. The already grazed areas are fertilised with slurry and the regrowth is mown at the beginning of July after a growth period of about six weeks.

Starting in the last season, the dairy cows were brought from end-June to mid-September to summer pastures at high altitude. This was primarily done to reduce the workload during the summer months. Between end of June and mid-September the areas close to the farm buildings are exclusively mown.

From mid-September to end-October, the animals graze again on the grassland located near to the farm. During this time, the management of the pastures is flexibly adapted to weather conditions, regrowth and livestock. In contrast to spring, either the grazing area made available is increased or the stocking time per area is reduced. From the end of October on, the animals remain in the loose housing during the winter months.

For didactic reasons, four dairy breeds (Braunvieh, Simmental, Tyrolean Grey and Holstein Frisian) as well as dairy sheep of the Lacaune breed are currently kept on the farm. For the sheep, a deep litter stable was built for the winter months. During the summer months, they remain for 150 days on the pasture all day long, whereby the system of flexible paddock and rotational stocking is used.

Since last year, the calves are born on the farm, but they remain on the farm only during the suckling period and are then transferred to another farm. They do not return on the farm until they are adult dairy cows. This was done for several reasons: workload and space problems are reduced; a larger proportion of the feed ration can be covered with the farm’s own feed and the off-farm purchase of forage can thus be further reduced. However, this also requires a high quality of the roughage, which is achieved by warm ventilation and a dehumidifier.

A special feature of the farm has been until last year the mixed grazing with milk sheep and the young cattle. The aim of it was to reduce the parasite pressure. Mixed grazing of dairy cows and dairy sheep would not be possible, as the sheep graze areas with slopes of more than 25% and the dairy cows would cause trampling damage there.

A large part of the produced cow's milk is delivered to the dairy as organic haymilk, and is currently paid with 0.83 € per litre. The rest of the cow’s milk and the sheep's milk is processed into cheese and yoghurt and sold in the school's farm shop. Customers are mainly the students as well as participants to the education courses held at the school.

Advantages

The changes in the management method reduced the amount of labour. The relocation of the young cattle and the grazing of the dairy cows on alpine pastures reduce especially in the summer months the workload. On the one hand, this makes it possible to concentrate on the forage harvest at the farm. On the other hand, it enables the two permanent employees to take holidays also during the summer months.

Adoption criteria

The organization and procedures on the farm are quite complex. Many aspects are only implemented for didactic reasons and would therefore be difficult to realise on small farms. For example, two milking parlours are needed, one for the dairy cows and one for the dairy sheep. In addition, two permanent employees are working full-time throughout the whole year. If, however, the small farms would concentrate only on the dairy cows or on the dairy sheep, individual aspects of the management system could certainly be implemented by them.

The prerequisites for the implementation are moderately steep grassland areas close to the farm, livestock breeds and lines that are suitable for grazing and that can cover their own energy requirements with grazing and hay, as well as an existing market for organic haymilk and farm products. In addition, farmers should be convinced of the usefulness of reducing concentrates and be ready to face a learning phase concerning grazing management.

Future prospects

For the future, it is an essential concern to achieve self-sufficiency in terms of meeting the own forage needs. For this reason, the feed ration will be continuously adjusted and the proportion of concentrates progressively reduced. In order to achieve this goal, however, suitable animal breeds and lines are also required. New breeds such as Original Braunvieh and Pinzgauer will be added to the animal herd in the future.

In order to increase animal welfare, the dehorning of the animals will be completely omitted in the future. In addition, mixed grazing with sheep and cattle will be reintroduced. The number of dairy cows kept shall be increased considerably. Since no more young animals are kept on the farm, this is also possible without an excessive increase in the stocking rate. In addition, there is a plan to establish a mother-bound rearing of calves in the future.

Grazing management (rotational stocking) combined with mowing:
"Extensive livestock farming and regional marketing of beef"

Farm: **Schornhof**
Location: **Aldein/Aldino (South Tyrol), ITALY**

Background

Until 2006, the organic farm was a conventional dairy farm. After the conversion in 2006, suckler cows and cattle for fattening are kept. Several aspects were decisive for this change from milk to meat production: On the one hand, almost half of the 24 hectares of grassland are not in the immediate vicinity of the farm. In addition, these more distant areas are rather meager pastures, which are not so well suited for milk production. On the other hand, this allows running the farm on a part-time basis, which is easier to do with cattle fattening than with dairy farming. For the farmer, the introduction of grazing was an additional essential point, because if the full potential of grazing is used, he considers grazing systems to be the most cost-effective forms of livestock husbandry. The greatest advantage of grazing is certainly the saving of working time. About half of the forage required for the animals has no longer to be mown, dried and collected, but is used by the animals directly on the pasture. Since the farmer wanted to establish a closed nutrient cycle on his farm as far as possible, no concentrates are fed to the animals and no off-farm forages are purchased, thus avoiding excessive off-farm nutrient inputs.

Detailed description

The stable was converted into a loose housing stable with an accompanying outdoor paddock. An increased animal welfare in the stable is provided by the outdoor paddock, a mobile wall that, if open, allows the cubicles to receive more sunlight as well as neck brushes, which are adjusted to different animal heights. Despite being kept in loose housing, the animals are not dehorned. A high quality of the roughage is achieved by means of an effective barn-drying system. During the grazing period, the animals are not additionally fed. During the winter months, they receive only hay from the farm's own grassland, i.e. they are not fed silage either.

All grassland areas are grazed, partly in combination with mowing: The pastures near the farm are grazed once in spring and once in autumn, the larch pastures during the summer months. The larches and other group of trees on the pastures provide sufficient shade for the animals if required. From the end of April on, the animals come out of the stable and can graze on the 12.6 ha of grazed permanent grassland areas around the farm. The grazing is carried out according to a rotation scheme on the basis of a flexible paddock system. The individual paddocks vary in size and are grazed by the animals in spring for around 21 days. Following this first use by the animals, the areas have a rest period of approximately 21 days before the first cut. Since Mid-May, the suckler cows and the calves are moved to the larch pastures. They grow on soils quite poor in nutrients, but exhibit a high biodiversity around 40 species per 10 m^2. In autumn, the animals return to the areas close to the farm. They graze there until around the beginning of November before being brought into the stable for the winter months.

The innovation of this farm is certainly also a result of the flexibility of the pasture management. While good planning of grazing and mowing is essential, a certain degree of flexibility in terms of adaptation to the currently available grass budget as well as a rapid reaction to changing weather conditions during the growing season are required too.

The farmer is a member of the 'Bioregio' cooperative. The members of the cooperative are organic mountain farmers who keep suckler cows and want to jointly market the beef from the young cattle at local level. The cows of the breeds Tyrolean Grey and Original Braunvieh are crossed with a bull of the breed Limousin. The 10- to 11-month-old young cattle with a life weight of 360 to 370 kg are slaughtered and their meat is assembled by a butcher as boxes containing a selection of different cuts. The young cattle's meat is marketed under the 'Bio*Beef' label, whereby, until now, the mixed packages have mainly been supplied to private households, restaurants and public institutions.

Advantages

By switching from dairy cattle husbandry to suckler cattle husbandry and meat production, as well as by establishing the grazing management, it was possible to significantly reduce the amount of workload. This labour saving makes it possible to run the business on a part-time basis and provides more time for family, holidays and free-time activities, especially in the summer months. In addition, the morning and evening control walks to the larch pastures in the summer months are an opportunity for the farmer to relax. For him, the control walks are not only a duty to be fulfilled, but also recovery and a balance to everyday life. In addition, tourists accommodated at the farm (agrotourism) like to see the grazing animals.

According to the farmer's statement, the profitability of the farm has developed positively. In addition, there is the fact that the farmer and his family are convinced of the need to run the farm in a closed nutrient cycle as far as possible. The farm has gained a good degree of independence by not using external concentrates and is therefore no longer dependent on the price of off-farm forage including concentrates and its fluctuations. The combination of suckler cow husbandry and grazing makes it possible to produce with minimal costs. The existing machinery is used to full capacity, fuel costs are low, no additional purchases of external forage are necessary and investments are only made in a targeted and cost-efficient manner.

Adoption criteria

As a prerequisite for the establishment of grazing management, there is a need for sufficient grazable areas in the immediate vicinity of the farm. Furthermore, grazing on the extensively managed pastures allows a reduction in workload in comparison to keeping the animals on farm the whole year round. The mountainous areas of South Tyrol require breeds suitable for grazing which are able to cover their own energy requirements in summer with pasture forage and in winter with hay.

The farmer considers grazing to be an important topic for his farm and for whole South Tyrol. The pasture, which is the natural way of feeding for ruminants, should be used more again. In addition, grazing is the most cost-effective form of husbandry when all the grazing potential is exploited. In South Tyrol, however, pasture is used little nowadays, partly because farmers are afraid that grassland would be damaged by the livestock and that the animals no longer produce the desired high individual milk yield.

Grazing must be carefully planned and carried out. However, a certain flexibility is also required, e.g. to be able to react quickly to changing weather conditions. For a correct implementation of the grazing system, specific technical knowledge is required and the correct handling of pasture systems must first be learned.

The correct mindset plays a role when switching from mowing to grazing, because it takes a certain amount of time for the system to establish itself. Many farmers believe, however, that they can easily switch the whole system from one growing season to the next. If grazing in the first year of conversion does not work as the farmers expected, they often return disappointed to the old system. Time and patience are therefore essential. In the first few years, a suitable grassland (dense sward with species tolerant to trampling) must be built up or maintained with targeted overseeding. In the beginning, gaps in the sward are not unusual and must be timely closed by means of oversowing. The weather and the areas have to be monitored constantly.

Finally, an essential aspect is that the farmer must be convinced of sustainable management, grazing and feeding without concentrates and silage. In addition, it would be useful if the whole family supports this idea.

Future prospects

Until now, the organically produced meat with the 'Bio*Beef' label has been delivered as mixed packages to interested customers. For the future, the cooperative also wants to market the meat directly via the supermarket. A first step in this direction will soon be taken with the first organic shop that will include the 'Bio*Beef' meat in its assortment and offer it in the meat counter.

Hay drying with warm air under the roof

Farm: **Hof Butendiek**

Location: **Seefeld, Lower Saxony**

Background

Since 1984 the family-owned farm Hof Butendieck is an organic farm. The marketing of organic products on a local scale is difficult, when there is no dairy plant in the surrounding area. This lead to the idea of direct marketing from the farm. In the beginning, the milk was manufactured on a small scale in the kitchen, which was a quite elaborate process. The milk was sold on weekly markets or directly via farm shop. Over a period of time, the products were further improved and developed until they were able to produce hay-milk to manufacture semi hard cheese. Hay-milk allows the intentional fermentation, which is not easily possible with cows feed by silage. Milk from cows feed by silage can contain butyric acid. This can cause cracking and ballooning cheese loafs. These cheese loafs are unsuitable for the market. Besides the aspect of product-safety there is a significant tastefulness with cheese produced from silage free milk. That is the reason to have two completely divided herds, which are held seperate during winter season. One group of cows is fed with silage, the other group is fed with hay as a feeding basis. All cows are allowed to pasture during summer season and are fed with hay, silage und concentrated fodder during winter season.

Today a vast amount of the produced milk of all 180 Holstein Frisian cows of the organic farm Hof Butendieck in Seefeld is processed to cheese and is distributed through food wholesalers, the farm shop and weekly markets. The wholesalers market cheese nationwide. Meanwhile there are various cream Cheese variants and a vast assortment of semi-hard cheese. Even though producing cheese comes with high amount of personnel und financial effort, it has the advantage of a higher value.

What were farmers' motivations

Hay as a feeding basis is much more challenging than wilted silage. Young grass in spring is energy rich and highly digestible, but due to not desirable weather conditions, it is often not possible to produce hay. In summer with long-term stable and dry weather conditions, the grass is older and stringy and therefore not in an optimal condition to produce milk. The divided cowherds (additional overheads and residual risks) together with forgone turnover due to silage feeding of some cows motivated the farmer to invest into hay drying. Now young grass beneficial to milk-production can be harvested and dried. During winter, all cows can be fed with hay because of sufficient hay forage. The risk of contamination of milk with butyric acid from silage is eliminated. Young cattle in other buildings can be fed further with cost-efficient silage. Another advantage of hay-production is, there are nearly no need for silage storage.

Hay drying as an innovation is the main guarantor of a safe and sustainable way of milking, profitable marketing and last but not least livelihood security for the organic farm.

Detailed description of the innovation

In recent times on many farms, hay was dried in drying lofts with blowers. Increasing stocks, higher energy content in silage and increasing costs of energy triggered farmers to shift away from hay drying in large scale. Large drying lofts are highly unusual in Northern Germany, while they are quite common in in Southern Germany.

With high amounts of internal labour together with a renowned company, the farm built a combined drying- and storage-loft. Three drying compartments are filled with pre-dried grass and warm air is blown upwards through the grass. The needed air is taken from below the hall roof. This air below the hall roof is warmer due to solar radiation. The needed temperature increase is lower, so is the energy conservation. In all it is more climate protecting. On the long run, it is planned to use renewable energy sources like wind energy and photovoltaic systems as a basis for hay drying. When the intended degree of dryness is reached, the hay is transferred to a hay storage box und the next stack of hay can be dried.

Results

For the farm, there are three bullet points of enhancement: Young grass can be harvested a number of times a year. This causes higher harvest yields in energy and dry matter per Square unit. It is not necessary to have dry weather to produce hay, because the drying facility is available. Hence, the feeding basis for the winter period is secured. This is a major advantage, because weather uncertainty induced by climate change is no longer a thread. Hay is the foundation for feeding the cows at Hof Butendiek. The produced milk has to be butyric acid free to be of value for cheese production. Due to the new drying facility, the farm is able to produce enough hay to feed all cows during the winter period. This means protection of the cheese production and marketing at a high level of added value.

Adoption criteria

It is possible to apply hay drying in Northern Germany to other farms if they are willing to increase the added value. This is mainly the case in cheese production with a reasonable amount of direct marketing, as shown at Hof Butendiek. So-called hay milk as a classical milk produced by dairy plants does not have the needed increase in value to justify an investment into hay drying facilities.

Future prospects

In a stationary drying facility, a high amount of fossil energy is needed. In the future, renewable energy can be used to dry hay on a yearly climate-neutral basis.

Tall fescue and structured grassland mixtures on moor sites as an alternative to the german ryegrass

Farm: **Torsten Cramer**

Location: **Apen, Lower Saxony**

Background

Practitioners are aware of the difficulty of successfully establishing valuable forage grasses on moor sites. The right choice of grass variety plays a decisive role alongside care and management adapted to the site and use. Due to its wintering tendency, German ryegrass, which is otherwise very powerful, also reaches its limits in difficult sites. Fescue is considered to be particularly persistent and productive. The meadow fescue should combine the high yields of the welsh ryegrass with the endurance of the meadow fescue.

The farmer tried different fescue and meadow fescue grass mixtures on a ryegrass insecure high moor site. These are to be established as an alternative to german ryegrass under practical farming conditions.

What were farmers’ motivations

The farmer is very open to new things and likes to try out new grass mixtures, always with the idea of optimising his yields and qualities. Moor soils represent a challenge, especially in the long-term establishment of grasses. In the farm of Torsten Cramer moor sites are the basis for farming. So he has almost only grassland on moor and he has to use it as efficiently as possible.

Very wet, very dry but also very cold weather conditions can damage many grasses. Some grasses can cope better with such weather conditions due to a deeper root system and a higher resistance. For example the fescue.

Against this background the farmer was motivated to try out new grasses on a moor site and was interested to find alternatives to perennial ryegrass for wet moor sites because of its unsatisfying persistence.

Detailed description of the innovation

The grasses were sown in August 2015 in demonstration plots to compare : in particular tall fescue vs. perennial ryegrass (cultivars for moor-soils) and structured grassland mixtures. The grasses have been tested for performance on a moor-site where perennial ryegrass is difficult to establish permanently. In Tabel 1 the grass mixtures and their share within the mixtures are listed.

Figure 1: Grass mixtures which are sown on moor site

grass mixtures
53 % german reygrass; 17 % timothy; 10 % Kentucky bluegrass; 20 % pointed fescue
100 % german reygrass
75 % german reygrass; 15 % Festulolium; 10 % timothy
70 % german reygrass; 10 % timothy; 20 % Festulolium
35 % german reygrass; 40 % tall fescue; 10 % pointed fescue; 10 % timothy; 5 % cocksfoot
40 % reygrass; 35 % Festulolium; 25 % Welsh reygrass
15 % german reygrass; 85 % tall fescue
10 % cocksfoot; 60 % tall fescue; 30 % Festulolium

The different grass mixtures were sown in demonstration plots. Depending on the composition of the mixture, the appropriate sowing strength was taken into account. One plot had a width of 6 metres and was 300 metres long. After successful establishment, the yield and quality of all mixtures were examined and assessed. Therfore a defined area of each plot was mown and weighed in order to measure the yield. After that the samples were then examined for quality in the laboratory. In order to determine which type of fescue is the best in terms of endurance and forage value, plots have been planted side by side. Yield and fodder quality of the single types were also compared.

There have been created trial plots to compare also single types of tall fescue varieties on their endurance, yield and quality.

Figure 2: Single types of Tall fescue, Festulolium and German reygrass which are part in the grass mixtures in Figure 1.

11	tall fescue: Type Quantum II
10	tall fescue: Type Barelite
9	tall fescue: Type Barolex
8	tall fescue: Type Bariane
7	tall fescue: Type Elodie
6	Festulolium: Felina
5	Festulolium: Lofa
4	Festulolium: Perseus
3	Festulolium: Fojtan
2	Festulolium: Becva
1	German reygrass: Type Aktiva

Results

The tall fescue could be very well established, as well as the german ryegrass and the meadow fescue. All grasses survived the first winter well and it wasn't very cold either. Wintering could not be observed for any variety or mixture. However, the very dry summer of 2018 showed obvious differences. After months of drought, the tall fescue could regenerate much faster than the german ryegrass.

Adoption criteria

Good weather conditions and know how of the farmer were essential to establish Festuca arundinacea successfully. Innovation can be adopted by farmers who have an interest in grasses and varieties and have the expertise to establish successful grasses. Breeding enables an ever improving range of varieties adapted to sites and farm uses.

Future prospects

Climate experts assume that in the future there will be more prolonged, very wet or very hot and dry weather conditions than ever before. Against this background, grasses must be found and established that can withstand the extreme weather better than others. The farmer who thinks about efficient use of his grassland for forage is considered innovative in this case.

Digitisation and technology: automated feeding and milking

Farm: **Henning Rothert**

Location: **Wittmund, Lower Saxony**

Background

The Rothert family farm is located in open marshland and is now managed by the third generation. Its foundation and purchase dates back to 1960. Today, 235 cows are kept in stalls with grazing.

The grazing is combined with an automatic milking system. The stalls are equipped with milking robots. Technology and digitisation play an important role in the company, as four milking robots and an automatic feeding system are now being used. In the farm, the grass and the grass silage are at the centre of the feeding. In order to achieve a high energy and protein content, the grass is cut as early as possible and supplemented with the components of pressed pulp and, if the grass is too young, also with alfalfa.

Modern technology is very important out on the fields too - the parallel drive system has been introduced for tractors. Digitisation has become an integral part of herd management - it also uses the recording of rumination for detecting heat. The company impresses with its sustainability and innovation and has always been involved in technical developments.

What were farmers' motivations

The Rothert company is very technically-minded and enjoys the combination of animals and technology. Animals are always paramount. In addition, full automation of feeding, including regular raking of the feed, makes working easier, especially in times when it becomes increasingly difficult to find reliable staff. The same applies to the milking robots. Automation helps to better plan management. This leaves more time for the family, which was also a great motivation.

Detailed description of the innovation

On the Rothert farm, almost everything runs fully automatically: the feeding, the pushing of the feed, the milking and grazing using a selection gate. Thus, automatic milking and grazing are ideally combined. With the Grazeway selection box, the cows themselves decide if and when they want to go outside to pasture. The Grazeway then uses the cow detection system to determine whether or not they are allowed to do so. Despite the large herd size of 235 cows, the manager's wish to graze the cows allows grazing through automation and the rounded grassland areas. The advantages for animal welfare, for example that the hoofs are cleaner and that older animals can become fitter again due to the greater freedom of movement, are key.

In the pasture, three groups of milking cows and one group of dry cows are separated. The automatic feeder mixes 5 to 6 mixtures per group of 60 cows a day. There are four cow groups, which means it makes up to 30 mixtures per day. Automatic feeding is based on the set amount of feed on the feed table. If it is less than 10 cm, the supply is replenished. The feeding takes place in a separate compartment, which is filled every 2 to 3 days with silage and the mixture components. If there is a risk of reheating in the silo, the feed rate is increased.

Feeding is so easy to plan. The feed at the feeding table is pushed forwards at very regular intervals, so that the animals constantly have something to eat.

Results

Due to digitisation and automation in feeding, the focus of stall work has shifted to monitoring and controlling cows and technology. The time, which was otherwise used for feeding work and other things, is now used to detect heat and observe specific individual animals. Overall, however, a significant reduction in workload can be felt. The aim was to replace personnel with technology in order to become more independent and counteract the difficulty of holding onto good, reliable personnel in the long term.

The selection gate to the pasture combined with the milking robots works very well. However, the number of milkings during grazing periods goes from 3 to 2.4 to 2.5 (observed particularly in good weather conditions), but grazing is very important to the farm. The milk yield is 9400 kg/cow/year.

Adoption criteria

The switch to fully automatic feeding in combination with milking robots is associated with high investment. It only makes sense for farms that are interested in the use of technology and would like to feed and milk. The selection gate, which controls the pasture management in combination with the milking robots, can only be used if the farm has suitable grazing areas around the stalls and grazing is possible.

Future prospects

In the future, however, an external worker will be sought to operate the technology. Expansion of the farm and further development are not planned. Two of the milking robots are now somewhat outdated and are to be replaced by new models.

Drone for grazing management

Farm: **Bernd Stührenberg**

Location: **Schwanewede, Lower Saxony**

Background

The Stührenberg farm lies on the Weser island Harriersand. Harriersand has a nutrient-rich river marsh landscape. The island's 800 ha consist mainly of permanent pastureland. The Stührenberg farm manages around 54 ha of pastureland, which due to its location and its consolidated area, is particularly well suited for pasture grazing. The freestall barn accommodates 120 cows and is furnished with two automated milking systems. Pasture access is controlled by an electronic pasture gate. Pasture grazing farms are of course very familiar with the additional time and effort involved in bringing the livestock from the pasture to the barn for milking. There are different ways of implementing this. When the grazing areas are close to the farm, it is possible to drive the cows to the barn on foot. Some herds are trained to react to the farmer's call and come to the barn on their own. When grazing areas are further away and are connected to the barn via livestock trails, bicycles or even cars are commonly used to drive the cattle. At any rate, it is a time-consuming procedure.

What were farmers' motivations

The Stührenberg farm has therefore decided to drive its livestock to the barn by means of a drone. Its operation and handling are quickly learnt and easy to carry out. The farmer also enjoys using this technological innovation and the combination of drone, milking robot and pasture.

Through previous observation of the cow herd, the farmer had already noticed that the cows reacted extremely well to the drone. This lead to the idea to use the drone as a drive-aid. On top of this, the drone offers further advantages. Using the drone's built-in, high-resolution camera, it is also possible to carry out a simultaneous area and sward check by assessing the condition of the pastureland. The cows quickly get used to the drone, there is no unrest amongst the herd and they make their way calmly towards the barn and the milking robot.

Detailed description of the innovation

The farm has always practised pasture grazing. Alongside the conversion to an automated milking system, the electronic pasture gate (Grazeway) was installed. The pasture gate Grazeway allows the cows to decide if and when they want to go outside to graze. The Grazeway then determines via the cow recognition system, whether they are allowed out or not. The idea of implementing the drone as a time- and effort-saving device to drive home cows that do not come voluntarily back to the barn from grazing, has proved extremely worthwhile. Due to the fact that milking is carried out around the clock, a cow check has to be carried out several times a day to determine which cow should be led to the milking robot and which must not. The farmer starts his drone from his farmyard and can follow and save direct video transmission on his tablet via the control panel. At the same time, he can also obtain a good overview of the condition of his pastureland.

The high-resolution camera makes it possible to decide, on the basis of the picture, whether new pastureland should be allocated, what condition the grass is in and whether substantial trampling damage could occur in wet conditions.

These are the ways in which the drone can support grazing management. By day, it can also make rapid observations of which cows are in heat and can monitor the animals' health.

Results

Since the introduction of the drone as a support tool in grazing management, it is possible to register a significant saving in time and effort. The farmer can now carry out cow observations from the comfort of his farmyard and additionally drive home the cows that are required to be milked by the automated milking system. Use of the drone in combination with the electronic pasture gate and milking robots make for an extremely efficient, effort saving and innovative overall concept. Use of the drone in very windy and wet weather is, however, difficult, due to the fact that the drone is extremely sensitive to wind and can therefore be damaged easily.

Adoption criteria

The acquisition of a drone as an aid in grazing management, along with the functions that it must possess, is a manageable investment. Farms looking for an aid to assist in driving cows in the direction of the barn would be well advised to purchase a drone, as long as the grazing areas are connected, and there are livestock trails leading to the barn. When using a drone, it is important that the operator chooses a position with a direct line of sight. Additionally, it is necessary to possess a drone licence if the drone is used in a commercial capacity.

Future prospects

The aim is to further improve the drone's radio connection in the future so that the drone can be started and controlled from the veranda at home. Apart from this, the concept is not suited for further development.

Weighing the harvested quantities in grassland and recording and calculation of nutrient flows

Farm: **Wist**
Location: **Wischhafen, Lower Saxony**

Background

Knowledge of the yield level is a basic prerequisite for optimum grassland management. The quantitative recording of grassland yields, especially on forage farms, is still not common practice due to the lack of weighing facilities, cost reasons and high time pressure during harvesting. Thus, there is no farm specific quantification of the harvest quantities.

Knowledge of the yield potential of the different grassland cuts is indispensable for optimum management of grassland on an area-specific basis and monitoring its success. Yield data and analyses of forage quality are the basis for successful forage management and a high-quality basic forage with a high milk yield. Only those who know their yields and forage qualities can make targeted and adapted forage and fertilisation planning possible and also get a precise overview of their forage and management costs. At the same time, an accurate recording of the yield makes possible this knowledge of the need for improvement measures. In addition, it provides the necessary information about the company's own basic feed stocks, which can be used to quickly identify a feed shortage and react to it in good time with additional purchases. Exact recording of the crop quantities also makes it clear to practitioners how to approach nutrient flows and the documentation required, which will be more important than ever in the future.

What were farmers' motivations

The farmer is highly interested in the topic and put in a lot of effort and planning. The layout of the farm in this respect helped to implement the technique, because there is only one possible way from the fields towards the silo and this is where the scale was placed. This prevented harvest workers to miss scaling their load, even if they were under a lot of time pressure due to weather conditions. The scaling machinery was supplemented by IT-technology that enabled the harvest workers to match the weight with a specific site electronically without delay.

Detailed description of the innovation

In order to generate the grassland and maize yields as accurately as possible, each wagon is recorded quantitatively and each field qualitatively, analysed and evaluated. The fresh grass sample is taken directly on the silo. A stationary scale is available for weighing. Tractors and shredders are each equipped with a GPS tracker in order to be able to trace routes after weighing. This enables the crop quantities to be allocated with unmistakable accuracy.

At the earliest six weeks after the weighing of the harvest quantities, the silages are again inspected for their quality and ingredients. Statements about the compaction work can also be made by calculating the storage density (TM kg/m^3). These results are relevant for a precise calculation of the feed ration and for checking the silage management and success.

Results

By weighing and accurately recording the yields, the farmer can now optimise his areas in a targeted manner and has a very good overview. The amount of work, on the other hand, is very high, but in the long term production can be increased through optimisation. The fertilization can be optimally adapted to the nutrient depletion, thus costs can be saved through the purchase of mineral fertilizers. The farmer also has precise data for feeding through the analysis of his feed.

Adoption criteria

The innovation can be adopted by any farmer. However, there are quite high initial costs for the installation and purchase of the scale. Also during the harvest a person has to stand at the scale and take the samples from the silo.

Future prospects

In the future it will be more important than ever to know exactly how much yield is harvested per hectare. Just as important is knowledge of the ingredients for targeted fertilisation and feed planning. In order to make the weighing system known, an event on the farm would be useful.

Own constructed aerator for grasslands located on the peat-muck soils characterised by low porosity

Farm: **Mariusz Duda Farm**
Location: **Wielkopolskie voivodeship Poland**

Background

Mr. Mariusz Duda runs his family farm in the west part of Wielkopolska voivodeship nearby the Opalenica town. This region has a long agricultural tradition of cereals and sugar beets cultivation, as well as animal production, especially dairy cows. Mr. Duda has taken his farm from his father and since that time he is increasing his production. At this moment he is cultivating an area of 120 ha and keeps 160 dairy cows with a high level of production, obtaining 10800 liters of milk per head during a year. This level of production can be obtained by the farmer thanks to his agricultural and economic know-how, own ambitions and constant improvement of the production and farm management system. The production on the farm is divided into two parts, the first is the crop production that is in 100 percent focused on the production of forage. The second part is the animal production based on the dairy herd that includes milk production and rearing young heifers. The animal nutrition is based on grass and maize silages. The maize is cultivated on the 50 ha of arable land in a conventional system and conserved as silage. The second part of the roughage feed production is based on the grasslands: 20 ha of temporary and 25 ha of permanent. The temporary grasslands consist of mix of intensive growing varieties of Medicago and Lolium westerwoldicum, which are sown on arable land. They are cut and the harvested yield is conserved as silage. The permanent grasslands in the farm are located on specific organic soils that have an inconvenient natural tendency to compactness and it is also increased due to the use of agricultural machinery. In the botanical composition of this grassland sward are dominated by Festuca arundinacea, Phleum pratense, Lolium perenne, Trifolium repens and Trifolium hybridum. Towards the process of soil compaction, a large part of those productive species falls out from the composition for other less productive species decreasing the amount of yield and its quality. This process cannot be even stopped or slowed towards regular renovation or other conventional cultivation treatments. The problem that has occurred in this case was how to provide optimal growth conditions for the sward to obtain a sufficient forage production.

Detailed description

The low grass production was a big problem especially when the farm started to extend the herd and increase their milk production. At that moment there wasn't any possibility to purchase new land for forage production due to no sale offers in the close neighborhood. The farmer with his father started to analyze the problem how to increase the production level on currently managed specific grassland. Their curiosity and ambitions lead them to seek a solution to the problem through discussions and the use of own ideas. The conclusions were that they need to search for a proper way to restore meadows by adjusting the suitable seed mixtures to the specific habitat. At the same time the challenge was to find an optimal cultivation treatment that will allow to ensure optimal conditions for the growth and development of valuable meadow plants, especially humidity-air relations in organic meadow soil characterized by low porosity. The father of Mr. Mariusz Duda came up to an idea of constructing a plate aerator that will allow to loosen the compaction and insert air to the sod layer. The aerator is built on the construction of a cultivator and it has a 3 meters working area. The working elements are cutting plates adapted from another machine (potato harvester) and they are installed one next to another within 20 cm gaps. The plates are cutting the sod to a depth of 10-15 cm. The depth is regulated by adding some extra weight to the machine. The treatment with the aerator is applied after the harvest of each regrowth and its use is depended on the weather conditions, especially humidity of the soil.

Results

Aeration ensures the insertion of air to the sod layer, which has a positive effect on the growth and development of the valuable meadow plants and prevents the sward from the degradation processes due to soil compaction caused by machinery traffic. It provides also a better use of nutrients from applied fertilizers. As a result, it is possible to produce larger amounts of grass-based feeds for dairy cows, improve the botanical composition what results in a better quality of forage and increases the efficiency of fertilizer application. Also, the aeration maintains for a longer period of use stable botanical composition of the sward, especially after the renovation of the meadows.

Adoption criteria

The constructed aerator can be used in other farms that have problems with grasslands that are located on soils with a natural tendency to surface compacting. Its construction is very simple and in some cases it can be homemade by a farmer with some mechanic skills, with parts from other machines. The aeration treatment of grassland needs also from the farmer a very good knowledge about their habitat especially the soil type and its moisture content. In dry conditions the treatment will be no effective and if there will be too much of water in the soil the aeration can cause significant damage to the sward. In many cases the decision about the implementation of the treatment needs to be made immediately, and if it is going to be wrong applied it can lead to damage of the sward, unnecessary labor and cost loss. The aeration can give also good results on grasslands that are damaged towards the use of heavy agricultural machines especially on the technical roadways.

Future prospects

In his vision of dairy farm development Mr Duda is focusing on sustainable intensification of grassland management with introduction of many innovations, like presented aerator. Thanks to the innovation the farmer has increased his fodder production from the grasslands based on organic soil and secured his forage base for the extending herd. In his opinion, the obtained forage has very good quality and can be used for high-level milk production. The farmer indicates that the construction of the aerator needs some improvements. The organic type of meadow soils forces still some adjustment of the aerator in order to increase the efficiency of its work. The constructors have some ideas how to improve it and build another model. The new construction will give the possibility to work with higher speed and at the same time will not damage the sward. Those adjustments can improve the work of the aerator, decrease the time necessary to aerate all of the meadows what can lower the cost of a single treatment and give the possibility to save labor costs. The farmer sees some threat concerning the changing climate, especially after the last very dry year. The grassland management on organic peat-muck soil in such years with unstable weather conditions can bring new problems and difficulties to obtain a suitable amount of forage.

Renovation of flooded meadows using meadow foxtail grass added to standard seed mixture

Farm: **Wojciech Piosik Farm**
Location: **Wielkopolskie voivodeship Poland**

Background

The monitored farm is localized in a specific geographical region of the Noteć river valley in the northern part of Wielkopolskie voivodeship. Farms in this region are characteristic by the fact that they are managing in a special habitat of the natural and semi-natural permanent grasslands localized on organic and alluvial soils. The local grasslands in the whole valley on area of 80000 ha are included in the Natura 2000 network and are a special area of conservation and protection of habitat and birds. Agricultural production in this region is orientated on high efficient milk production with the use of local grasslands as the main feed base. The specific habitat with good quality organic and alluvial soils and grassland drainage system can be included as one of the best grassland production regions in Wielkopolskie voivodeship. The presented case study is a multi-generational family farm owned by Mr. Wojciech Piosik and his wife Bogumiła where they are working with their three sons. The farm area is 140 hectares, with the amount of 155.25 total LU of dairy and beef cattle. Forage production for cattle is divided into two parts. It includes 36 hectares of maize for silage using the whole plants and 32 hectares of maize for production of corn grain silage. The 15 hectares of the arable land is used for the cultivation of cereals as a component for concentrate feeds. The second part is grassland feed production, based mainly on the 25 hectares of high efficient permanent meadows, 17 hectares of cut temporary grassland sown on the arable land and 15 hectares of recently purchased, periodically flooded meadows, that are located directly next to the Noteć river. For the project case study and the created excel file these meadows are included as the “rangeland area”. The main animal production is based on the 110 milk cows of the Holstein Friesian breed with the young heifers and calves. Additionally, in the farm 15 beef cattle of different crosses are kept.

Detailed description

The farm was restructured in the 2000 year when the owners focused only on high efficient milk production. Since then the owners increased year by year the dairy production and in 2016 year, they have made a large modernization using the EU funds and bought a fully new machinery for the hay and wilted grass silage production that had improved in a significant way the production. In the further increase of animal production the limiting factor was the amounts of forages. One of the reasonable solutions was to purchase or rent more agriculturally utilized area for forage production. Because of the situation on the local land market, that does not allow to obtain a good quality agricultural land due its high prices, forced the farmer to search for a different solution. In some moment there occurred a possibility to purchase for a relatively low price 15 ha of semi-natural meadows. The main problem of this area was its specific habitat and abandonment of forage production for a long time, which caused significant changes in their botanical composition. With a high share of weeds and low productivity grass species in the botanical composition the meadow sward was not suitable for an efficient milk production. During the growing season the meadows are also periodically flooded by the river waters, what also provides to the degradation of the botanical composition and time to time disables the possibility of their harvest. The main problem in that moment was, how to optimize the fodder production on such meadows in the specific conditions of organic and alluvial soils and periodic floods. In order to solve the problem, the farmer decided to renovate the newly obtained meadows. First, he regulated the water conditions by cleaning and restoring the existing drainage system and dig some new drainage ditches. The second step was to increase the participation of valuable forage species in the sward. The problem that has appeared, was the lack of seed mixtures containing species resistant to such extreme habitat conditions on the market. All of the seed mixtures offered were composed out of a high-value species however, no mixture included a composition that had in its content grasses resistant to periodically floods. The solution to that problem is the main innovation developed by the farmer presented in the Inno4Grass Project. Due to the lack of seed mixtures containing meadow foxtail, the farmer ordered seeds of this species in a seed company for supplementing the composition of the standard commercial mixture used in renovation. The meadow foxtail is typical grass species which occurs in the botanical composition of flooded meadows in very low share and is naturally present on the Noteć river meadows. It is a grass with good fodder value, resistant to harsh climatic conditions and periodically floods, well-growing on alluvial soils.

Results

The direct result of this innovation worked out in this particular farm, because it is possible to obtain higher and better quality dry matter yields from the new grasslands that were originally very low productive. The extra fodder production can be used as a reserve or for the increase of the herd and animal production. Renovation with the use of the seed mixture with addition of meadow foxtail not only improve the grassland production but also had given the sward better tolerance for floods and the persistence of the performed renovation.

Adoption criteria

Innovation created at the presented farm can be adapted directly by other farmers from the Noteć valley and others that are managing grasslands located directly to rivers that have a tendency to periodic floods. The addition of meadow foxtail to different market grass or grass-legume seed mixtures for the renovation of grasslands located on organic and moistly soils can be applicable in the whole area of temperate climate in Europe, where this species occurs naturally. Also, very useful can be the mechanism developed with the innovation. Seed companies are composing seed mixtures mainly for typical grassland sites. The strategy of adding to a standard mixture a special species of grasses, legumes or herbs can improve them and add some new use and economical values. Addition of species that are less productive but more tolerant to different abiotic factors, for example: periodic drought, extensive moisture, extreme soil pH, etc. can create a seed composition for the renovation of grassland in site-specific conditions. Additionally, the effect of renovation will be more persistent.

Future prospects

From the farmer point of view the innovation cannot be already fully evaluated. This year (2018) is the first year of use and is characterized by untypical weather because of drought occurred in Poland. In the situation of lack of periodically floods it is difficult to evaluate the running of innovation. By the way, the meadows had yielded this year very well. Farmer has some further ideas for improvement the applied solution, like using a standard seed mixture with addition of two-three different varieties of meadow foxtail. The main threat that is considered by the farmer is the possibility of occurring a really extreme year with high water levels and having a year without any gathered yield. In such situation the farmer cannot fully rely on the fodder from the "rangeland" meadows. The threat of presented innovation is also the availability of the seeds of meadow foxtail on the market.

Application of irrigation on grasslands due to avoid the water deficit in the soil

Farm: **Andrzej Szulc Farm**
Location: **Wielkopolskie voivodeship Poland**

Background

The farm of Mister Andrzej Szulc is localized in the northern-east part of Wielkopolska voivodeship in the village Mikołajewo near the town Wągrowiec. Mr. Szulc runs a high efficient dairy farm producing large amounts of milk and breeds Holstein-Friesian cattle not only for own purposes but also for sale as high-value thoroughbred material. In the farm are also kept young bulls for fattening. At the moment of the creation of this case study he is farming on a total area of 146 hectares. The biggest difficulty that farmers from Mr Szulc neighbourhood need to struggle are the local very light sandy soils. Agricultural land near the Mikołajewo village is mainly localised on sandy soils with poor content of organic matter. This soils are strongly permeable and have no capacity for water retention. The drought effect occurs very quickly even in the times of minor water deficiencies. Plant production in Mr Szulc farm is divided into two parts. The first one is the cultivation of maize that is carried out on the 90 hectares of arable land. Maize for forage is produced in the farm in two different systems and it depends on the obtained final product. The farmer is producing classic silage out of the whole plants and also makes silage out of whole but shredded maize cobs (Corn Cob Mix). The second part is the production of forage on grasslands. The farm produces feed on both permanent and temporary grasslands. The permanent grasslands are localized on the area of 15 hectares and there is managed a typical meadow production thanks to with the farm can obtain an average number of 3 cuts per year. The main species of the botanical composition on those grasslands are: Festuca pratensis, Lolium perenne, Festuca arundinacea, Dactylis glomerata and Trifolium repens. The obtained sward yield is conserved as haylage. The main grassland forage production is obtained from the 36 hectares of temporary grasslands established on the arable land. This production is held in a very intensive way and towards different improvements and innovations, the farmer can obtain 4-5 cuts per year. The sown mixtures on irrigated area are based on highly productive varieties of ryegrass species (Lolium multiflorum and Lolium hybridum). On the non-irrigated area the alfalfa is sown. The whole plant production in the farm is set for the feed production. Not always it can be enough amount to secure the feed base, so the farmer purchases roughage on the local market and conserves it by himself. He tries to buy it especially in the time of abundance and stores it for the thinner times. Milk production in the farm is based on a herd of 180 milk cows of the Holstein-Friesian breed. During the lactation period, they are kept on a feeding system that provides a very high average level of milk production from cow and by a year its 11200 litres. With the youth animals that are retained for the renewal of the milking herd and young males for fattening in the farm is kept of 320 LU of cattle. Such high numbers and stable production of milk would not be possible to obtain by traditional farming and managing systems especially in the habitat of so poorly productive soils. The farmer had to search for new solutions and ideas to obtain higher and stable production of feeds especially in the case of periods of drought.

Detailed description

The farmer, through his own deduction and searching for a solution to the problem, decided to install an irrigation system on the farm. The first attempt to irrigate grasslands were made using reel-operated sprinklers. This solution gave good results, but it was very labor-intensive and expensive. Finally, the farm decided to implement a large investment and install a ramp transferred semi-automatic irrigation system. This investment was possible to realize thanks to subsidies obtained from the European Agricultural Fund for Rural Development from the Project PROW 2017-2013. Bridge irrigation system is working on the farm on two fields. Each installation is 220 m width prepared specially for the field size. It is driven by an electric engine powered by a generator. Water is obtained from deep wells and stored in artificial mid-field ponds. Maximum water flow of the installation is 45 m^3/h and a topical dose of 15 l/m^2. The dose is determined according to daily requirements. This installation can be working if it is necessary towards the whole vegetation season and can be used for 26 hectares of the arable land. The new obtained water conditions on the arable land have given the possibility to apply of seed mixture composed of high-yielding grass species: Lolium multiflorum and Lolium hybridum. These temporary grasslands are commonly used for two years.

Results

This solution allowed for the independence of field production from weather conditions, especially in the case of drought, and it has led to the possibility of using new grass mixtures containing high-yielding species and varieties. Thanks to irrigation the high application of fertilizers is possible leading to obtain high yield of DM and necessary amount of silage for dairy cows TMR feeding. These elements together with the introduction of an efficient technology of harvesting and feed conservation technique allowed not only to maximize the production of feed but also to reduce its unit production costs, allowing obtaining profitable milk production at a very high level. Presented elements directly have given the farmer a possibility to produce high amounts of feeds on the owned agricultural area and reduce the quantity of bought forage, decreasing the costs of milk production in the farm and had given chance to obtain higher profit.

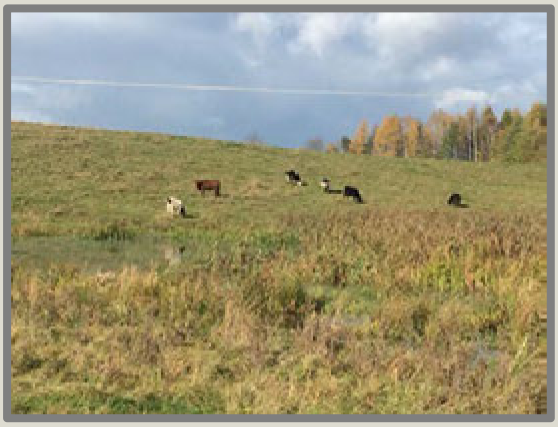
Adoption criteria

The presented example shows that the implementation of an irrigation system can give evident effects in producing forage on temporary grassland in Polish site conditions. However this example is slightly extreme because the farm is located in a specific habitat characterized by light sandy soils, in which periodic droughts occur. The innovation can help to obtain better dry matter yields and a more rationalized production on grasslands in some similar farms that are producing feeds in an extreme habitat with water deficits. The irrigation of grasslands can be effective only when there is available a cheap source of water and a very effective system of irrigation. The irrigation of grasslands can be an interesting subject in the reality of climate changes and a higher threat of droughts. The installation located on arable land can be used not only for grass production but also for other arable crops.

Future prospects

In the farmer opinion, the obtained amounts of feed from grasslands are on a very high level and are satisfying for him. Still he is open to new solutions that can improve feed production especially obtained from grasslands. He is looking forward to implement an easy and low-cost system to automatically define the exact dose of water. In the farm there also appeared a problem with the change in legal regulations in Polish water law. Changes of the rates for the use of water (15 gr/m^3 of deep well water), not taken into account at the investment planning stage, presently puts the profitability of using the irrigation system on grassland under a big question mark.

Adjustment of feeding system of beef animals to different type of grasslands occurring in the farm



Farm: **Danuta Wójcicka Farm**
Location: **Warmińsko-Mazurskie voivodship Poland**

Background

The presented innovative farm is localized in the North-Eastern part of Poland. This region is the third one voivodship in Poland with the highest share of permanent grasslands in agriculturally utilized area (AUA) and is distinguished by the highest percentage of grasslands that are grazed. The region is well known out of its milk and beef production. Farm described in this case study is a family farm located in a small village Najdymowo near the town Biskupiec. It is run by Mrs. Danuta Wójcicka and her two sons. The farm is focused on beef production and suckler cows rearing. The farm owns 198 hectares of agricultural land. The plant production is based mainly on extensive grasslands and arable land sown with cereals and lupine, all of those are used as forage. The grasslands share in AUA in the farm is 87%. It consists of 136 hectare of different type of permanent meadows and pastures and 29.5 hectare of temporary grasslands. The area of 87 hectares of permanent meadows that are exclusively cut and the sward yield is conserved as haylage is very varied with their productivity. The average number of obtained cuts from these meadows is two per year and it is highly depends on the weather conditions. Part of the meadows is used very extensively, it means only one cut carried out in a restricted time. This is a result of restriction in management due to their inclusion into agro-environmental program. The pasture is located nearby the farm buildings and is divided into two parts by the local road. The 49 hectares of pasture are also partially included in the agro-environmental program and their use is very extensive. In those parts of grassland, the fertilization is on a very low level and applied only in the early spring. They need to be preserved in their natural botanical composition so any improvement of sward by more productive species using e.g. oversowing is not allowed. The farmer, when she describes her farm, says also a lot about high natural values of those grassland. The farm is located in a scenic hilly and forest area. On the pasture two natural ponds are located that are a natural reservoir of water. The mid-field trees give the animals some shade in sunny days. All of that gives the whole farm a lot of charm and forms an attractive landscape. The diversity of the grasslands and their different forage production potential was the main challenge for the family to create an effective system of beef production. The main goal was to obtain a livestock production that will secure the family income with simultaneous efficient use of the grassland resources and maintain the natural values of the local habitats. Important was also the partial reduction of labor time so the ambitious sons can start their studies.

Detailed description

The innovation is a rational use of fodder resources occurring in the farm by adjustment of different beef cattle feeding to different grassland types. In order to rationalize production costs and reduce labor input, the farm divided own grasslands in terms of their productivity and type of use, as well as to the nutritional requirements of the proper beef cattle feeding groups. The mowing and grazing of the permanent grasslands depends on its location and forage production potential. Also the conserved forage use for a specific group of animals depends on its quality and is based on the type of grassland it was gathered. The farm indicates various feeding groups of the beef cattle. Beef bulls for intensive fattening kept all the time in the barn receive the best forage obtained from the best quality mowed grasslands (mainly from temporary), conserved in the form of haylage. In addition, the concentrates prepared in the farm out of own cereals and lupine with a supplementation of bought protein granulate and minerals are used. Heifers for fattening in the summer are mainly grazing the pasture sward in a rotational system and receive prepared concentrates directly on the pasture. In cases of periodical low productivity of the sward, they also obtain some conserved roughage. In the winter they are kept in a cowshed and are fed with conserved feeds with addition of concentrates (similar to the bulls). The third group is the suckler cows herd. In the farm cows for reproduction and rearing are selected during period when they are young heifers. Animals for the reproduction of the herd are chosen in the way to improve its beef production value. Those ones with negative features for reproduction are designed for fattening. With the suckler cows group are also kept young ones that still stay with the cows, pregnant heifers and heifers ready for reproduction. This herd is kept all the year on the extensive pastures that are included in the agro-environmental program in the system of continuous grazing. During winter time the herd has a cowshed available and the pasture area is limited to reduce the destruction of the sod. Suckler cows in the dry period receive the worst quality feeds obtained from meadows included in the agro-environmental program. In the farm there are also kept bulls for reproduction. The insemination is mainly natural and takes place on the pasture when the bull is together with the cows chosen for reproduction. The reproduction bulls are selected from the animals that are born from artificial insemination. This way secures an inflow of new genes in the herd. Those bulls are kept and fed in the same way as heifers for fattening.

Results

Thanks to the innovation the farmer has rationalized her production costs and reduced labour input especially during vegetation period. The farmer divided own grasslands in terms of their productivity and type of use, as well as to the nutritional requirements of the proper beef cattle feeding groups. Thanks to the introduced feeding system, the farm relatively quickly receives bulls ready for sale due to an intensive feeding as well as heifers fattening on less intensive pastures. An additional benefit of introducing such solution is, noticeable by the farmer, good condition of suckler cows intended for breeding, which significantly improves the rate of calving on the farm as well as animal health and welfare. The extensive production is also compensated thanks to payments received from agro-environmental program.

Adoption criteria

The system has had worked out in this case because the farm is running in a very extensive way. All even very minor optimizations of the feeding system can give evident positive effects. The system can be directly adapted to other similar beef farms that are located in such specific habitats, where grasslands are diversified in terms of forage production potential and need to adjust of different beef cattle feeding to various grassland types. In order to transfer the innovation to a dairy farm, there should be made some changes in the animal production groups and the intensity of feeding. An important element that is supporting this system are the obtained environmental payments. They not only help but also implement a different style of the production that the presented system uses very well.

Future prospects

In the farmer's opinion the specialized beef production carried out in the farm with the amount of owned grasslands gives a possibility to run a profitable production and gives some chances for development. She points out that the grazing during the summer time significantly reduces the costs. But there is a lot of things that need improvement to get a better economic result. To reduce costs and work time there should be made some investments in the mechanization of the cowshed like automatic manure removal system and installation of automatic drinkers. There is also still a need for improving the herd genetic to obtain better average daily gains and feed utilization. The farmer sees also possibilities to increase the grassland production by improving the botanical composition to obtain higher yields. Some adjustments can be also made in the pasture management system that will increase their utilization.

Herbs introduction in grassland sward, grass fed milk and dairy products sold directly from the farm

Farm: **Grzegorz Łuczak Farm**
Location: **Łódź Voivodeship Poland**

Background

Mr. Grzegorz Łuczak together with his wife runs a small farm located in the central part of Poland in the village Woźniaków near the town Kutno. The farmer's main idea for farm running is to produce high-quality milk and process it to dairy products sold directly from the farm. He and his wife were a typical full-time working people when someday they decided to start their own business. They always wanted to get back to their childhood when they were living in the countryside and were recalling the food that was produced by their grandparents in those times, its flavor values and quality impregnable nowadays. Thanks to those memories they decided to buy a small farm in the nearby village and start to produce milk from a few dairy cows. In that time they have been treating it as a hobby and still were working in theirs jobs. From the beginning they decided to process the obtained milk into different dairy products and sell them directly from the farm. Farm produces a wide assortment of dairy products: fresh milk, butter, cream, kefir, yogurt in different flavors, cottage cheese, cream cheese, short and long-ripening cheese. The entire obtained profit was invested back to the farm and the equipment for the milk processing. In that way today Mr. Łuczak and his wife are working only on the farm and processing milk into many different dairy products. They are farming on an area of 20 hectares of agricultural land and in the moment of creating this case study they were mainly used as grasslands. The forage production is based on 12 hectares of permanent grasslands where the botanical composition is dominated by Lolium perenne, Festuca pratensis, Dactylis glomerata, Phleum pratense, Trifolium pratense. The 8 hectares of arable land owned by the farmer are equally sown by alfalfa to obtain forage with higher content of proteins and by grass-legume mixtures. The whole plant production is free from chemicals and is kept on a very extensive level for obtaining the best quality of forage. The farm herd is based on 11 milk cows and with the young ones is 14,7 LU big. There are kept animals of few different breeds: Holstein Friesian, Brown Swiss, Montbeliarde, Meuse-Rhine-Issel and their crosses. The average amount of milk obtained from cow is 7500 liters per year. The herd is also part of a scientific project in which, under a specially prepared breeding program and chemical analysis of milk, the selection of cows was implemented, which produce milk with altered protein composition, thanks to which the obtained product will have a less allergenic effect. The farmer is consistently searching for different solutions, ideas and innovations to obtain the best milk for processing and increasing quality of flavor values and in the end high price for his dairy products. He is aware that a large part of the quality of milk can be obtained on grassland and the quality of the produced forage.

Detailed description

In order to obtain the best quality of forage produced on grasslands, the farmer was searching not only for a solution how to increase their productivity but at the same time he wanted to obtain forage with a higher quality and nutrition value. Towards his own curiosity and determination, he found out that he can achieve those goals towards changes in the botanical composition of the grassland sward. Introducing new productive and valuable species of grasses can increase productivity and herbs can increase the nutrition value of the obtained fodder. The idea of introducing herbs to grassland sward with the aim to produce high-quality forage was taken from the literature and practice of other organic farms in Poland and Europe. The main problem during the implementation of this innovation was the lack of herbal seed mixtures for grassland establishment on the domestic market, especially for the production of feed for dairy cattle. The solution that turned out was the available herbal seed mixtures for horse pastures renovation. One of the Polish seed companies has in theirs offer an herbal mixture composed out of Carum carvi, Cichorium intybus, Sanguisorba officinalis, Foeniculum vulgare, Petroselinum crispum, Plantago lanceolata, Achillea millefolium, Pimpinella saxifraga, Daucus carota, and Galium verum. The farmer uses the seeds as a supplement for grass-legume seed mixtures by grassland establishment and renovation. The increased production of milk has given the farm a possibility to get larger amounts of the dairy products that can be sold to consumers. To increase the sales range farmer participates in a sales project based on a website (lokalnyrolnik.pl) where customers can order the products from local farmers and make their payment. In this way the farmer knows the amount and type of the product to prepare. There is also prepared a logistic chain the farmer is obligated to transport his product to a central warehouse located in few Polish cities. There are prepared boxes with different products, which are delivered to the place pointed by the customer (preferable are places where boxes can be pick up by few customers e.g. greengrocer, kindergarten).

Results

Meadow herbs in the sward are included in the mixture for improvement of the quality of obtained feed, finally affecting the better milk quality. Meadow herbs in the herbage have also a positive effect on animal health and welfare. Innovation allows the farm to improve the health and welfare of animals and obtain high-quality milk necessary for its processing on the farm in order to obtain final high-quality dairy products for direct marketing. The multi-species mixtures can also increase the tastiness of the forage and efficiency of feed utilization. The quality of raw milk is of high importance in the production of dairy farm products, especially long-term ripened cheese. Valuable herbage from grassland used in dairy cows feeding allows obtaining milk with a significantly reduced content of unfavorable micro-organisms from the Clostridium group and others in relation to milk based on maize silage. Such milk is desirable for long-term ripened cheese production. The presence of herbs has also an environmental cause increasing the biodiversity of the grasslands.

Adoption criteria

Innovation implemented in the farm can be easily adapted by other farmers producing high-quality milk. Renovation of grasslands is one of the most important treatments for maintaining theirs productivity. The introduction of herbs in the botanical composition can be made just by adding them to the sown standard mixture. The presence of herbs in the sward can not only be valuable for the quality of the milk but the increased nutrition value of the forage can give a preventive bonus in the animal welfare and healthiness.

Future prospects

At this moment the farmer is in the first year of the innovation implementation and just started to feed cows with the new forage. He can`t objectively comment about the obtained yields because due the drought year the grasslands didn't show their potential. He admits that the obtained forage is willingly eaten by the cows and he observes that they are searching for the haylage parts containing herbs. The farmer is looking also for improvement of the composition of sowing mixture that will be typically prepared for dairy cows. One of the biggest problems is the availability of seeds of the different herbs. The reproduction of such species is not carried out in Poland so they need to be bought in foreign countries.

A holistic transition from conventional dairy cattle to agroecological dairy goat farm:

"Gaining self-sufficiency and resilience by producing, processing and marketing grassland-based products, and by educational activities for children"

Farm: **Vincent DELOBEL, 'Chèvrerie de la Croix de la Grise (Goatfold of the Grey Cross)'**

Location: **HAVINNES (TOURNAI), BELGIUM**

Picture 1 (Credit: Vincent Delobel)

Background

Francis Delobel and Christiane Faux, Vincent's parents, created the farm in 1982. They started a conventional farm with Holstein-Friesian dairy cows. They progressively discovered the 'skids and nonsense' of this conventional farming. In 1997, they became organic for better connecting with nature and being consistent with their vision about their place in nature. They first delivered all their milk production to a French dairy factory. Some years later, this dairy factory was bought by a larger group (Lactalis) that was not interested to collect their milk anymore. They then heard that a cheese factory was looking for organic goat milk. They decided selling their dairy cows and bought 200 dairy goats. Again, all their milk production was delivered to the cheese factory. After some years, the relationships with this factory degraded. Francis and Christiane took another drastic decision: selling three quarters of their goat flock, building a cheese production workshop with the result of the sale and starting to process their milk into cheese. Cheese was mainly sold on local markets. This corresponded to their wish to give back the human and social dimensions to their profession.

The farm was still small, about 20 ha. The half was permanent grassland and the other half arable land where forage crops (cereals and temporary grasslands in rotation) were grown. This was not enough for guaranteeing a sufficient income. Therefore, other activities were needed. Francis and

Christiane thought offering educational activities to children from primary schools. These activities initiated children into nature and farm life. It was a success.

Vincent (pictures 1 and 2) graduated from Wageningen University in The Netherlands where he obtained a Master in Rural Ethnography in 2014. He took over the farm of his parents in 2016.

Picture 2 (Credit: Vincent Delobel)

Detailed description

In 2018, the farm has an area of 23 ha, 9 ha of permanent grassland and 14 ha of arable land including 9 ha of temporary grasslands and 5 ha of complex cereal/pulse mixtures. These mixtures are harvested as grain and used as concentrate feed for goats. The most complex ones can contain rye (*Secale cereale*), triticale (x *Triticosecale*), oats (*Avena sativa* and *A. nuda*), spelt (*Triticum spelta*), forage pea (*Pisum sativum*), and vetch (*Vicia sativa*) (picture 3). Permanent grasslands are mainly grazed and temporary grasslands are cut for hay and grazed.


Picture 3 (Credit: Vincent Delobel)

This dairy goat system is very innovative notably because it is one of the few in North West Europe where goats can graze and are not kept indoors in a barn their whole life (pictures 4 and 5). The area grazed by dairy goats is managed in a rotational system. Rotation is organized with fixed external fences and perpendicular mobile electric fences by modules of three grazing days. The first day, dairy goats have access to an area corresponding to one and a half grazing day. Then the electric fence is moved the second and third days, the new daily area corresponding for each of these days to 0.75 grazing day. There is no electric back fence. This system allows more daily space the first day but the grass in excess is consumed the second and third days while respecting a maximum of three days per period of stay. The fourth day, the system starts again on a new area. The rest period is at least 40 days for controlling goat internal parasites.

Temporary grasslands are sown with a complex forage mixture including 14 species of perennial grasses (3 species, 3 cultivars), perennial legumes (5 species, 9 cultivars), chicory (*Cichorium intybus*), plantain (*Plantago lanceolata*), and forage winter oilseed rape (*Brassica napus*) as a 'starter' (1,5 kg/ha). Chicory is used as a dock (*Rumex* spp.) control mean on wet heavy soils. Its root system is similar to dock and it is supposed to take up its ecological niche. Plantain and chicory provide a lot of minerals, proteins, and tannins to the animals. Their tannins help to control goat internal parasites. Animals find also tannins in shrub and tree leaves in hedges (picture 4). Forage oilseed rape harvested as hay does not induce an unpleasant taste to milk. The high plant diversity of this forage mixture is appreciated by goats. It is cut four times per year for producing hay. When hay is not dry enough, it is harvested by a pick-up loader wagon and it is dried out in barn on wooden pallets between straw bales with a blowing system (3-5 HP). Temporary grasslands are kept for three to five years. They are followed by cereal/pulse mixtures for grain in the crop rotation. Lactating goats ingest about 2 kg of DM of hay per day when kept indoors.


Picture 4 (Credit: Vincent Delobel)


Picture 5 (Credit: Vincent Delobel)

The main objectives of the grazing system consist in producing high quality grass for dairy goats, decreasing their internal parasite pressure, and reducing daily work associated with the move of electric fences. Regarding the control of workload for moving fences, the 4-wire Gallagher system has been adopted because it is easy to handle. Seasonal dairy production is synchronized with grass growth. It starts in April and ends in autumn. In rainy days of the grazing period, goats have to be fed in barn with hay because grazed fresh grass would be too wet. Hay should be high quality at that lactation period. In contrast, hay distributed in winter can be lower quality because there is no milk production at that period of the year. Flexibility of the feeding system is thus a necessity during the grazing period.

Goats are Saanen crosses with a high proportion of Saanen blood and a smaller proportion of Poitevine blood. There are about 80 goats, 2 bucks and 20 female kids.

Vincent fitted in with the strategies of his parents: developing a thrifty and self-sufficient system, resilient and resistant to crisis, close to nature. This was achieved by decreasing production costs, processing a large part of raw milk, developing a customer base and selling processed products in short and local marketing chain.

He developed also several innovative agroecological techniques: agroforestry for timber production on arable land, orchard of ancient cultivars of fruit trees, complex legume-based forage mixtures for temporary grasslands, complex cereal/pulse mixtures for grain production, and reduced tillage techniques. In continuation of his father’s practice, part of soil work is made by draft horses in complement to a small tractor.

Vincent is always looking for innovations and improvements of his system. He kept contacts with Wageningen university researchers and developed relationships with several other universities and research centres in Belgium and other European countries.

He founded a local group of innovative farmers who meet regularly for exchanging experience and experiment results. This group clusters about 30 farms that are conventional or organic and share the same concern about the development of agroecological practices. They consider themselves as representatives of the ‘new peasantry’.

He is also active in policy and lobbying activities at Belgian and international levels for defending peasant rights.

Picture 6 (Credit: Vincent Delobel)

Picture 7 (Credit: Vincent Delobel)

Results

Dairy goats produce 450 litre of milk per animal and per year. Total annual production is about 30,000 litres.

All milk is sold as raw milk or processed in raw milk cheese. Cheese is fresh or fermented and presented in different shapes (e.g. crottin, little cheese ball, small cheese log, goat milk camembert) (pictures 6 and 7). Fresh cheese is sold at about 13€/kg and fermented cheese at about 25€/kg. Consumers highly appreciate milk and cheese quality. There is no intermediate; the added value is kept in the farm.

The stocking rate is about 1.1 livestock unit (LU) per ha of grassland area and 0.85 LU per ha of agricultural area.

The educational farm welcomes 1,500 children per year (pictures 8 and 9). Children lead for instance goats to grassland plots and make other activities such as goat milking, cheese making and tasting, initiation to environmental problems, organic farming and agroecology, and wild plant and bird watching. Children can also make a farm tour in a horse-drawn wagon or ride horses. At the end of the visit, each child receives a cheese and brings it back home which contributes to product promotion. Five-day stays cost about 110 euros. The price of one-day visit is about 10 euros.


Picture 8 (Credit: Vincent Delobel)


Picture 9 (Credit: Vincent Delobel)

This agroecological system on a very small farm has been able to create two jobs. Francis and Christiane are still working half-time on the farm. This is an impressive performance.

Adoption criteria

The system is working because it is small scale and very flexible. The adoption of this resilient, thrifty and self-sufficient system has been motivated by survival. The farm is too small for providing a decent income to a family in a conventional system. The alternative would have been to enlarge farm size which would have been difficult because of access to land problems and would also have required massive debt.

The success of this farm is based on a progressive, well-thought transformation, and on a clear strategy that was also defined little by little for facing agricultural income degradation and dependency on agro-food industries.

A strength of this farm is its coherent approach. Innovations did not consist in the adoption of isolated techniques but in a holistic approach where all elements are complementing each other and ensure the profitability of the whole system.

Future prospects

Vincent has the objective to continue improving the farming system. The following topics are his priorities. He would like to develop a better organic manure management for reducing nutrient and particularly nitrogen losses. He considers that losses are too important during the composting process. He will explore other manure treatments such as Bokashi. He would also like to test the effect of the addition of whey, the by-product of cheese production, on litter quality and fermentation. He wants to further develop his no-till crop rotation. Reducing parasite pressure in goats, especially in young animals, is a permanent concern in his grazing system. New sources of tannins for instance could be identified and better used. He wants to progressively increase fruit production and tree plantation in general in his agroforestry system. Improving infrastructures and better equipments are important for reducing workload. He has also the ambition to reduce energy consumption and move towards a fossil energy-free farming system.

Alain Peeters, RHEA
January 2019

A holistic transition of a dairy and beef cattle farm towards agroecology:
"Gaining self-sufficiency by replacing commercial inputs by local resources and resilience by producing, processing and marketing grassland-based products"

Farm: **Dany and Nathalie DUBOIS, 'Ferme du Moulin (Mill farm)'**

Location: **GROSAGE (CHIEVRES), BELGIUM**

Picture 1

Background

Dany Dubois is born in 1968 (pictures 1 and 2). He graduated in Veterinary sciences in a Belgian university. He started working as a vet and, in 1993, he inherited the mixed farm of his parents. It was a small (30 ha) conventional farm combining several arable crops and a herd of dual-purpose Belgian Blue and dairy Holstein-Friesian cattle. At that time, milk was sold to a dairy factory and fattened animals to wholesale meat traders. Crops were used for feeding animals. Dany took over the farm as a hobby activity in addition to his main vet job.

In 1998, he catched a lymphoma, a type of cancer that is acknowledged in France as a professional disease due to pesticides. His doctor told him also that this cancer type is frequently recorded among farmers. The cancer was treated for five years before he recovered. A period when he thought a lot to the effects of the 'juggernaut of the agribusiness sector' and to the future and profitability of his own farm. He finally decided to give up his vet job and to focus on the development of his farm.

In 2007, Dany and his wife Nathalie decided to convert the farm to organic farming. They understood that their small farm could not survive in a global market framework. Their priority was to become forage and manure self-sufficient. They also decided to diversify their productions. They progressively replaced the ancient Belgian Blue and Holstein-Friesian herd by 60 dairy Jersey cows (120 animals in total) and 30 Salers cows for beef meat production (67 animals in total). They also started raising some pigs and poultry. Green maize silage and purchased soybean meal were substituted by lucerne (*Medicago sativa*). Forage self-sufficiency was achieved through a grass-based diet for both cattle types by a good management of grazed permanent grasslands, conserved lucerne for winterfeeding, and fodder cereal and pulse grain produced on the farm as concentrate feed. Crop fertilization was based on farmyard manure compost. Dany and Nathalie developed a shop in the farm, started producing butter, ice cream, yogurt, sorbet, cheese, raw milk and sold these dairy products, veal, beef, pork and poultry meat and eggs in their own shop. Consequently, they controlled the whole food chain, from production to marketing, from soil to clients.

The farm has now an area of 83 ha, 38 ha of arable land including about 30 ha of lucerne and 45 ha of permanent grasslands (picture 3). On arable land, the crop rotation begins with three to four years of a lucerne-based forage mixture followed by one or two years of cereal and cereal/pulse mixtures (triticale or spelt-oats-fodder pea) for fodder grain production. Lucerne mixture contains also red clover (*Trifolium pratense*), cocksfoot (*Dactylis glomerata*), hybrid ryegrass (*Lolium* x *boucheanum*), and timothy (*Phleum pratense*). It is harvested three to four times a year and conserved for the housing period as hay or silage. Grains are regularly crushed by the mobile mill of a contractor for making the concentrate feed of livestock ration.

Picture 2 (Credit: FUGEA)

Picture 3 (Credit: FUGEA)

Detailed description

In the last 25 years, Dany and Nathalie aimed at developing a thrifty and self-sufficient system, resilient and resistant to crisis. This was achieved by decreasing production costs, diversifying productions, processing raw products, developing a customer base and a marketing strategy for selling processed products.

Although the farm grew up from 30 to 83 ha in 25 years, investments in buildings and machinery were limited. For instance, the choice was made to invest first in butter and not in cheese production because investments in machines are lower for butter. Butter has also not to be stored, it is sold quickly. This reduces investments in buildings and storage shelving units.

A rotational grazing system, inspired by the 'Pochon's method', a famous farmer from Brittany (France) who developed a system based on white clover, was applied to grazed permanent grasslands. The area devoted to Jersey dairy cows (picture 4) is grazed during an extended period from March to December. It is divided into 25 plots that are grazed for about two days per plot and per grazing cycle. Rest periods range from 40 to 50 days according to seasons. The spontaneous vegetation of grassland is dominated by perennial ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*). Cocksfoot, plantain (*Plantago lanceolata*) and tall fescue (*Festuca arundinacea*) are also widespread. Nitrogen fixation by clover boosts grass yields. Clover also improves animal intake and forage quality. Lactating cows are supplemented by a concentrate feed mixture made of cereal and pulse grain. Jersey cows are particularly well adapted to grass transformation into milk thanks to their high intake capacity and rustic character compared to Holstein-Friesian breed. In winter, they are fed with lucerne hay or silage, green cereal/pulse silage, and grain mixture. However, the housing period is restricted to three months. Winter feeding costs are thus very low. This system is also very healthy for the animals.

The grazing system is simpler for suckler Salers cows (picture 5) and heifers.

Overall stocking rate is 2.5 livestock units (LU) per ha of grassland area and about 2 LU per ha of agricultural area.


Picture 4 (Credit: FUGEA)


Picture 5 (Credit: FUGEA)

Results

Total annual dairy production reaches 300,000 litres. It corresponds to an annual average of about 5,000 litres per cow (the average in the UK in conventional farming is about 6,000 l/cow in Jersey breed). Half of the milk production is delivered to a dairy factory. The other half is processed in the farm into a variety of dairy products and sold in the farm shop. This short and local marketing system is a way to control price. Whatever the level and the variability of World market prices, farm prices are stable and fair.

The high fat milk content of Jersey breed (5.5% fat) is particularly well adapted to cream production that can be processed into butter and ice cream. Only 16 to 17 litres of milk are necessary for producing one kg of butter. The ratio is close to 22 litres for one kg for most other dairy breeds.

About 150 kg of butter are sold every week in the farm shop all the yearlong. There is no winter decrease thanks to high conserved forage quality. Cows ingest about 15 kg of dry matter per day and per animal including about 12 kg of hay and silage grass at that period of the year.
Pig breed is local (Landrace and crosses). Skimmed milk, the by-product of butter production, is used for feeding piglets in complement to farm cereal grain.
With regard to beef meat production, Salers bulls and heifers are slaughtered at 42 months. Carcass weight reaches then 420 kg. They are classified in R-O category of the European system. Meat is cut by a butcher, vacuum packed and sold in farm shop.
Both cattle breeds are easy to raise. Calving is natural, they are disease resistant, and the grass-based system and the extended grazing period reduce workload a lot by decreasing cleaning and feeding work in barn.
A large part of productions is sold in the farm shop (picture 6), another part is sold to a minimarket, a bakery, restaurants, school canteens and joint purchasing groups. The choice has been made not to sell products to supermarkets because of their strategy to put pressure on producers for getting minimum product prices. Recently, a client list has been drawn up. Emails are regularly sent to members of this mailing list for announcing availability of specific products.
Clients are from the region and also from Flanders, Brussels and more remote places. They acknowledge the quality of the farm products. It is also worth noting that the difference between farm and supermarket prices is very small. Added value remain in the farm, there is no need to increase price more.
This agroecological system has been able to create 2.5 jobs on the farm. Dany and Nathalie are indeed now helped by their oldest son François.

Adoption criteria

The adoption of this resilient, thrifty and self-sufficient system has been motivated by survival. In 1993, the farm was too small for providing a decent income to a family. The alternative would have been to enlarge farm size which would have been difficult because of access to land problems and would also have required massive debt.
Dany's health problems were also a strong motivation for converting the farm to organic farming.

The success of this farm is based on a progressive, well-thought transformation, and on a clear strategy that was also defined little by little for facing agricultural income degradation. The family designed this strategy for escaping from the well-known 'scissor effect' that consists in the continuous increase of input price and the fluctuation and decrease of agricultural product price.

A strength of this farm is its coherent approach. Innovations did not consist in the adoption of isolated techniques but in a holistic approach where all elements are complementing each other and ensure the profitability of the whole system.

Future prospects

According to Dany, the conversion to organic farming is first and foremost an intellectual revolution. It also requires more knowledge for optimising livestock management.

Time availability is the most limiting element. Not all dairy production can for instance be processed and sold in the farm. Another job could be created but the cost of an employee would be too high.

A meat cutting workshop could be built in the future. This will maybe be the next project.

The approach can be adopted by any farmer by changing what has to be changed for adapting techniques and system to local conditions of each farm.

Alain Peeters, RHEA

January 2019

Picture 6 (Credit: FUGEA)

A holistic transition of a mixed farming system combining annual crops and dairy cattle towards agroecology:

"Innovation through production, processing and marketing of grassland-based animal products"

Farm: **"VELGHE Jean-Marie and Arnaud"**

Location: **BAUGNIES (PERUWELZ), BELGIUM**

Picture 1 (Credit: sambre-meuse.lanouvellegazette.be)

Background

The Velghe father and son farm (picture 1) is a mixed farm integrating annual arable crops, temporary and permanent grasslands and a dairy cow herd. It is located in Péruwelz (Wallonia, Belgium). The grandfather was a young Flemish farmer when he immigrated to Wallonia in 1959 and started farming on 20 ha. Jean-Marie, the father born in 1960, progressively increased farm size up to 100 ha and herd importance up to 70 dairy cows. He constructed several buildings such as air-conditioned warehouse storage for potato tubers, a modern free-stall cow barn with straw bedding and equipped with a milking robot, a structure for barn hay drying, several buildings for machinery including a mechanic's workshop. He diversified cropping activities by adding to traditional regional crops, cereals and sugar beet, more profitable industrial productions such as potato, spinach, green bean and pea. In parallel, he converted the dual-purpose cattle breed of the farm into a specialized high merit Holstein-Friesian dairy cowherd. In a first step, these dairy cows were partly fed by grazed permanent grasslands, grass and green maize silage and also by massive use of purchased concentrate feed including soybean meal. This changed over time (see below). In addition to farm activities, Jean-Marie developed an agricultural contractor business starting with organic manure spreaders and later on with several agricultural tools for direct drilling, and modern harrows for superficial soil work and cracking. Jean-Marie is considered today as a pioneer of sustainable farming practices in Belgium given his numerous efforts for notably developing no-till techniques, green manure, farmyard manure composting, herbaceous field margins, barn hay drying instead of grass silage, large forage self-sufficiency for cattle feeding and decreased pesticide and fertilizer use. Arno, the son born in 1987, his wife and his sister are now working in the farm too. They are developing dairy product processing and marketing activities.

Detailed description

Jean-Marie adopted two main strategies in the last 25 years: increasing income by choosing high profitable farming activities such as milk and vegetables, and improving farm heritage by improving soil and decreasing erosion and pollutions. He first adopted the typical rationale of the conventional agriculture system by increasing farm size and crop and animal yields. Farm size enlargement necessitated large investments and required important loans for buying land, machines, tools, animal genetics, and for constructing buildings. Increasing yields was achieved by an intensive use of fertilizers, pesticides, animal feed (green maize cropping and concentrate feeding) which induced high production costs.

This system generated stress and negative environmental consequences. After a disastrous erosion incident that destroyed an important part of a large potato field, Jean-Marie started thinking to the limits of the system and tried to reduce soil degradation and erosion by using compost, buffer strips and reduced tillage techniques. Observing the beneficial results of the adoption of soil conservation techniques and thus more and more sensitized to the importance of soil life and structure, he started to progressively reduce the use of soluble fertilizers, herbicides, fungicides and insecticides. This caused a reduction of production costs that became little by little a major strategy of the farm. Reduced tillage techniques have also decreased working time which in turn induced stress reduction and availability for other activities. Another profitable activity became then possible, the business of agricultural contractor. In 2018, about 1,000 to 1,500 ha were worked for other farms by the equipment of the Velghe company.

Understanding the high economic potential of the cost reduction rationale, Jean-Marie applied it to several farm activities and notably to animal feeding. He started producing conserved forage in legume-based temporary grassland as an alternative to green maize silage. For improving forage grass quality, he built a hay-drying barn for replacing grass silage. Conserved grass quality became consequently so good that temporary grasslands finished by replacing totally the surface cropped for green maize (picture 2). Grass protein replaced also soybean meal protein of purchased feed. Finally all expenses linked with commercial animal feed were stopped. Dairy cow diet was based to a large extent on grazed grass and barn dried hay. This diet is now completed by on-farm produced cereal and cereal/pulse grain mixtures. The rate of forage self-sufficiency is close to 100%. The management of permanent grasslands was very much improved by the adoption of a dynamic rotational grazing system (one to three occupation days per plot and per grazing cycle combined with long rest periods) on the 21 plots in the dairy cow grazing area and the 14 plots in the heifer grazing area. This management had an extremely good impact on grassland vegetation quality. White clover abundance increased a lot in the sward and all synthetic nitrogen fertilization was abandoned. In temporary grasslands, an innovative mixture was designed for replacing the traditional, heavily nitrogen fertilized monoculture of perennial ryegrass (*Lolium perenne*) that produces good quality forage but is difficult to wilt and not drought resistant. A complex mixture of several grass (*Dactylis glomerata*, *Festuca arundinacea* and *Phleum pratense*) and legume (*Medicago sativa*, *Trifolium repens*) species has been adopted. It produces high forage amount, is easy to wilt and well adapted to longer drought periods of a changing climate. Moreover, it does not require synthetic fertilizer. This mixture is cultivated on arable land in rotation with annual crops. It stores carbon in soils, improves soil structure and soil life, fix high amount of nitrogen that is partly available for the following crops, and control arable weeds. Forage produced from these temporary grasslands and grain and straw from on-farm produced cereals are part of a nice cycle where nutrients from grass and grain are excreted by ruminants in barn and mixed with straw for making a farmyard manure that is composted and spread again on arable land as an organic fertilizer. Consequently, increasing forage self-sufficiency also decreased production costs associated to fertilizers and herbicides in annual crop productions.

Despite the obligation to reimbursing important loans notably for the free-ranging cow shed and the milking robot, Jean-Marie decided in 2015 adopting a new daring strategy: decreasing the number of dairy cows, crossbreeding the high-yielding Holstein-Friesian cows with lower yielding but higher quality milk Normande breed blood, decreasing the proportion of milk production sold to the dairy factory for processing the remaining part of milk for making cheese and sell it in short and local marketing chain in a new shop built in the farm itself. Arnaud trained himself in a local agricultural school for learning how to make quality cheese.

The most recent achievement is the cessation of industrial crop (potato and vegetables) production and of all the commercial input use associated to these crops for focusing on dairy products.

Results

In one generation, a very small farm created by an immigrant farmer became a large efficient farm that is considered as an exemplary agroecological system. It innovated in different domains related to fertilization, weed, disease and pest control, reduced tillage techniques, animal feeding, grazing system, grass/legume forage mixtures, forage conservation, carbon storage in soils and reduction of pollutions. This had also a positive impact on biodiversity below and above soil surface.

In 2018, about one quarter of the total milk volume of the farm has been transformed into cheese, yogurt, ice-cream, butter, fresh milk and pastry. The raw milk hard-cheese, similar to the 'Tomme' or the 'Comté' types of French mountain regions, has been awarded the same year as the best raw milk farm cheese of Wallonia (picture 3). Cheese sales overcame the business plan forecast for that year. Clients are mainly from the village and the surroundings but progressively they are also coming from small more remote towns. It is expected that the totality of milk production will be soon processed into cheese and sold in the farm shop.

Another important achievement consisted in creating jobs on the farm. Not only Jean-Marie has a successor since Arnaud is associated to his father's and grandfather's farm but two other jobs were created. In about 30 years, the number of jobs on the farm raised from one to four. This is spectacular in a period of fast farm disappearance and where few young farmers are ready to take over the farm of their parents mainly because of a lack of profitability. This demonstrates that there are alternatives to the dominant model that is based on a race to farm size and productivity increase. At the opposite, this new model is based on the use of local resources that replaces commercial inputs and allows forage and nutrient self-sufficiency, on the decrease of production costs, on product processing and short and local marketing of this processed food.

Picture 2 (Credit: laprovince.be) Picture 3 (Credit: nordeclair.be)

Adoption criteria

The success of this farm is based on a progressive, well-thought transformation, and on a clear strategy that was also defined little by little for facing the challenges of soil quality and agricultural market price degradation. The farmer designed this strategy for escaping from the well-known 'scissor effect' that consists in the continuous increase of input price and the fluctuation and decrease of agricultural product price.

A strength of this farm is its coherent approach. Innovations did not consist in the adoption of isolated techniques but in a holistic approach where all elements are complementing each other and ensure the profitability of the whole system.

Jean-Marie has been also always open to scientific and technical information. He considered that reliable advisors are important supports but after consulting experts he thought by himself for defining his own strategy. He has also been always ready to collaborate with researchers for organizing experiments or making analysis on his farm.

He considers that the return to the ancient 'peasant' model combined with new techniques and knowledge (e.a. milking robot, agricultural machinery, and no-till system) is necessary for surviving.

Future prospects

This approach can be adopted by any farmer, by changing what has to be changed, for adapting techniques and system to local conditions of each farm. This farm demonstrates that there is no fatality. Even in a context of high loans, a farmer is not locked-in in a deleterious system. He can change his strategy and his system. This gives hope for a better future of European farming.

Alain Peeters, RHEA

January 2019

Minimal losses in bunker silage production



Farm: **Ekenäs**
Location: **SÖDERMANLAND, SWEDEN**

Text & Photos: Rolf Spörndly, 2019

Background

Ekenäs Farm and manor is located south of Stockholm in Sweden. It is a 400 ha organic farm with 200 dairy cows that is the backbone of Oscar and Lilly Lamm´s Foundation, which supports science within nature conservation with special emphasis on soil, water, plant protection and landscape. The farm is commercially operated, delivering the profits to the Foundation. However, the manager often welcomes demonstration trials and other activities using the farm as a model. The farm is also frequently used for scientific meetings supported by the Foundation.

The dairy farm delivers organic milk certified by KRAV. The old barn housing 60 dairy cows was replaced in 2012 with a brand new loose housing system for the dairy cows and for 180 young stock. All feeds are produced on the farm and the animals are fed a total mixed ration (TMR).

In the period 2012–2014, Ekenäs Farm was one of 15 farms selected for a project aimed at studying the *de facto* losses in silage making occurring at farm level in Swedish silage production. Research at the Swedish University of Agricultural Sciences (SLU) to understand why dry matter (DM) losses occur, and hopefully find actions to reduce the losses, had found that Ekenäs Farm had less losses than other farms using bunker silos. The measurements were repeated to ensure that there were no errors in measuring and to analyse the management regime applied on Ekenäs Farm during ensiling.

Detailed description

Swedish farms are growing rapidly in size in order to achieve more effective production and to cut costs per kg milk produced. The size of the average dairy herd has increased from around 30 cows per farm in 2000 to around 90 cows per farm in 2018. Most Swedish dairy farms make silage in bunker silos. With the rapid increase in herd size, it has become common for farms to employ a contractor to harvest the forage. A self-propelled forage harvester in combination with three tractors with wagons is common and forms an effective harvest chain to deliver the crop to the front of the silo, which is filled in a short time. The current recommendation is for fast filling and closing of the silo, since ensiling is an anaerobic process.

The management system at Ekenäs Farm is the opposite. They use a towed wagon with a forage chopper mounted on. This means that when the wagon is full, no chopping can be carried out while the tractor is transporting the forage to the silo for unloading. This results in very slow filling of the silo. During the time when the tractor is going to the field to chop and fill the next load, another tractor is continuously packing the silo. With this extended time of packing, the grass is compacted hard as a floor before the next layer goes into the silo and the silage density is very high. When the silo is filled in the end of the day, the practice at Ekenäs Farm is not to cover the silo with plastic sheeting, which is the custom on most other farms, but instead to leave the silo open until the next morning. When work starts the next morning and the tractor and chopping wagon makes the first trip to the field for a load, the compaction tractor 'after-packs' the silage already present in the silo, for at least an hour. By that time the herbage in the silo has lost its turgor, has settled and is easily compacted further. Now the silo is finally ready for covering with plastic. The farm uses only one layer of common silo plastic, on top of which is spread a 10–15 cm layer of fine sand over the complete silo surface.

Ekenäs Farm is organic and uses no silage additive. Organic production also means very high silage consumption to provide all 200 cows and 180 young stock with feed. Despite the size of the farm, it has bunker silos with very moderate width (most around 6 m wide). This of course means that the farm has more silos, but the time it takes to empty each silo at un-loading is much shorter. This in turn means that the silo is open and exposed to oxygen shorter time at feed-out. The management system for feeding out the silage is also careful, using the so-called 'step-ladder' method to minimise losses. Any losses from the upper layer fall onto the lower step, instead of ending up on the floor and being spoiled.

Results

This management system meant that Ekenäs Farm emerged with the lowest silage losses in the study run by SLU. On average, mean DM losses in the other bunker silos in the study were 14.1%, while the three silos at Ekenäs Farm had average DM losses of 4.7%. Many potential factors influencing the level of losses on the different farms were analysed (Spörndly, 2018). This revealed that one factor had significant, and quite surprising, effects. When all farms with bunker silos were ranked according to filling speed, i.e. kg DM loaded into the silo per hour, the results illustrated in Figure 1 were obtained.

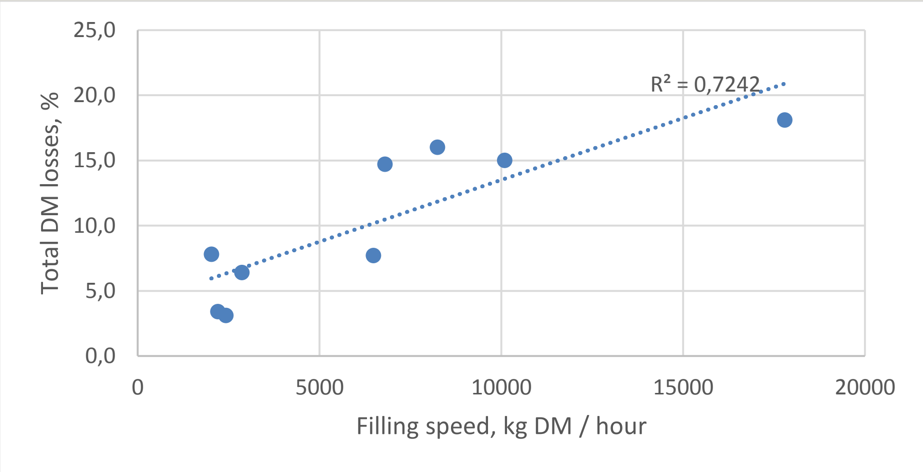


Figure 1. Dry matter (DM) losses as a function of filling speed in nine bunker silos. Hours are counted from start to end of filling, including night-time hours.

The three silos at Ekenäs Farm were among the four silos with the lowest DM losses (in the bottom left-hand corner of Figure 1). Another parameter identified as important for silage DM losses in the project at SLU was the air-tightness of the silo during storage. Small leaks that did not lead to inferior silage quality when measured at opening did affect the survival of aerobic microbes such as yeast, which was responsible for a fast temperature increase after opening the silo, resulting in large DM losses. Long unloading time, i.e. the time when the silage is exposed to air, gave higher total DM losses on other farms. However, all these parameters were at their lowest in the system on Ekenäs Farm, which had outstanding results. Despite low filling speed, with extended compaction, sand covering and low silo width, silage DM losses on Ekenäs Farm were 10 percentage units lower than on the average Swedish farm.

Adoption criteria

The 'filling speed' has become a new concept in silage management planning. Farms with very large and wide silos, and which employ entrepreneurs with high capacity for filling these silos, have found a way to adapt. Instead of filling and finishing one silo at a time, they fill two silos simultaneously. This requires two compaction tractors, but overall it takes the same time for the contractor to deliver the forage to the two silos. However, the filling speed of each silo is halved, enabling compaction to a much higher degree. It also results in more silage DM in each silo, due to higher density. Most important, though, is gives a more stable silage during feed-out, with less heating problems and lower losses.

Future prospects

The importance of covering the bunker silos with a heavy material such as sand was not fully investigated. This should be done and, if it turns out that covering with sand is a superior method, a technical, labour-saving method for spreading and removing the sand needs to be developed.

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Separated slurry and distribution pipeline – better spreading in organic agriculture



Farm: **Ersmarksängarna**
Location: **VÄSTERBOTTEN, SWEDEN**

Photos: Alfred Olofsson, Linda af Geijersstam & Viking Genetics

Text: Hulda Wirsén, 2019

Background

Ersmarksängarna Farm lies near Skellefteå in Västerbotten, northern Sweden. The farm has around 185 dairy cows in an organic production system that yields 10500 kg milk per cow and year. The cows are milked three times a day. All bull calves are sold and in total the farm has just over 260 livestock units. The workforce consists of 6.5 full-time workers, within the family and with one employee. In addition, machinery contractors are hired for some of the field work.

The farm has an arable acreage of 400 ha and this area is continually being expanded as land becomes available for leasing. The soils on the farm are mainly silt-based river valley sediments that were deposited when the last ice age ended around 8500 years ago (2/3 of total area). A substantial proportion (1/3) also have a high organic matter content (>20% humus) and can be wet during spring tillage.

The climate in the region can be defined as cold continental, with mean annual precipitation of 600–700 mm. A characteristic feature is the long winter, with snow cover for around 150 days per year and an average snow depth of 60 cm. Spring tillage usually starts during May and is completed during the first half of June. In winter, the temperature can fall to between -35 and -40°C, while the maximum temperature in summer can be around 30°C. Mean annual temperature is 0°C.

Another important factor for crop growth in the region is the long summer days, i.e. many hours of sunlight. During May and June, the sun does not sink below the horizon and therefore grass basically grows around the clock. Since snow melt is in April–May, when the light is already intensive, trafficability of the wetter soils is a limiting factor during spring tillage, especially on the farm's organic soils.

Detailed description

Back in 1998, Ersmarksängarna Farm began separating its slurry and then spreading the liquid fraction via a distribution pipeline, instead of storing it all in a conventional slurry tank. There is only a short window for slurry spreading in spring and, since the farm is organic, slurry is the only fertiliser used. This is problematic for the farm's grassland, which grows very rapidly, since it poses a risk of spores in the feed. In addition, the trafficability of the soil is limited once the ground thaws. Separating the slurry and spreading it via a pipeline has been a winning concept for the farm, which pioneered this system in northern Sweden.

Advantages:

- Light equipment = Spreading can begin earlier in spring and go on for longer.
- Light equipment = Decreased soil compaction gives larger yield and higher clover content in forage.
- Lower nitrogen losses, since more slurry can be spread in the spring.
- Greater scope to spread slurry on grassland, low risk of spores in the feed.
- Lower transport and machinery costs.

Separation, storage and spreading

The system requires thin slurry, so separation of the slurry is essential. This takes place in a pumping station between the culvert and the slurry tank. The separator is run every day except on the coldest days of the year. The dry solid phase can be used as bedding if sawdust is not available. In recent years, it has mainly been used as a fertiliser and soil amendment.

The farm has a 2000 m^3 slurry tank and a manure pad for the solid fraction. In addition, it uses a satellite tank that can hold 4000 m^3 slurry. All slurry stored on the farm is spread via the pipeline in autumn and spring. The pipeline has a 2 km radius and distributes 100 ton slurry per hour.
Some maintenance has been required over the years, but the faults have been relatively minor. The pipeline is still intact and the farmer believes it can last another 5–10 years, although it is already 20 years old. The spreading hoses have been replaced three times and the pump has been replaced once. In the early days there were some problems with leaky connections, but these have worked well since being repaired.

Other slurry spreading

The slurry that is stored in the satellite tank is spread with a conventional slurry tanker, which is contracted in. The slurry tanker has a capacity of 25 m^3 and a large proportion of the slurry is spread in the autumn. Autumn spreading is relatively common in northern Sweden, since the window for spring tillage is short. Autumn spreading results in slightly larger nitrogen losses than spring spreading. However, research carried out at the Swedish University of Agricultural Sciences (SLU) in Umeå shows that nitrogen losses in winter are lower in northern Sweden, owing to the early ground frost and the long-lasting snow cover (Lindén, 2008).

Crop rotation

Ersmarksängarna Farm grows forage crops and grain cereal. A five-year rotation is applied on the 400 ha of arable land (Table 1) and the farmer is careful to renew the grass swards frequently, in order to have large yield and high quality. The aim is to achieve good cropping and profitable production per kg total solids, and therefore the leys are never allowed to lie for more than three years.

Table 1. The crop rotation used for productive temporary grassland on Ersmarksängarna Farm

Year 1	Year 2	Year 3	Year 4	Year 5
Spring barley	Spring barley, undersown ley	Ley 1	Ley 2	Ley 3

The ley is undersown in spring barley, which is grown for grain or ensiled earlier. The spring barley variety used is either 2-row or 6-row and the usual seed rate with an undersown crop is 170 kg/ha. The seed rate for other grain cereals is usually 190 kg/ha. A mixture of spring wheat and vetch is sometimes used as the main crop and it is harvested as whole-crop silage. The grassland seed mix consists of an organic blend adapted for northern Sweden. The seed rate used for this is generally around 22 kg/ha.

Fertilisation plan

Ersmarksängarna Farm applies a cropping rotation with planned fertiliser doses. The liquid fraction of the slurry is spread over the farm, with the focus on the grass leys. The entire area around the farm, both grassland and cropland, receives liquid slurry in the spring, corresponding to around 1/3 of the total slurry volume. On the other grassland area, where the slurry is spread with a slurry tanker, the leys receive 15–20 ton/ha in autumn. The cereals in this latter area are fertilised in spring. All leys receive slurry for the regrowth in summer.

The solid fraction, which contains more phosphorus and potassium, is applied to cereal after ploughing the ley to meet the nutrient requirement and distribution as well as possible. Some fields that are in a lower potassium class according to the soil chemical classification system have greater problems with winter kill, and phosphorus and potassium play an important role in dealing with this. All cereals are also treated later with purchased fertiliser, Biofer 10-3-1, which is approved for organic cropping.

Results

It is difficult to identify any direct financial gain from the system, according to the farmer. However, it increased the possibility to convert the farm to organic. It was easier to reduce the use of mineral fertiliser once the spreading arrangements on the farm became so much better.

The previous level of soil compaction has also decreased, giving larger yields. The farmer considers this important for financial sustainability and also for long-term cropping on the soil.

Adoption criteria

Lower transport costs and distribution of phosphorus

Slurry separation is relatively common in some parts of Europe, but has still not gained a solid foothold in Sweden. It has been tested in some areas. In Halland in southern Sweden, advisors reported lower transport costs in 2011. Since a large proportion of the phosphorus content in the manure ends up in the solid fraction, it can be transported in a very cost-effective way and spread on land far from the main farm buildings (Bergström Nilsson & Blackert, 2011).

Future fertilisation strategies

The trend is for fewer, larger farms, including in northern Sweden. Since the best agricultural soils in that region are often located along river valleys, this means that the layout on larger farms is more unfavourable and the transport costs increase. Separating slurry is therefore an interesting way of reducing production costs in order to maintain competitiveness.

Future prospects

Climate change will mean a longer growing season for the northern hemisphere. Already the growing season is around 2 weeks longer for farmers in northern Sweden. The autumn has become longer and wetter and farmers must prepare for even wetter conditions. This poses a high risk of soil compaction, since the soils in the region are often weak in structure and hold a lot of water during spring and autumn tillage. When looking for ways to reduce the weight of equipment in field work, this must be considered. Spreading slurry via a distribution pipeline can be an excellent approach on farms with a suitable layout.

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Selling ice-cream adds value to farm-produced milk

Farm: **Björketorp**
Location: **BLEKINGE, SWEDEN**

Photo: Linda af Geijersstam
Text: Nilla Nilsdotter-Linde, 2019

Background

Björketorp Farm (220 ha) is located close to Ronneby in south-east Sweden, in a temperate continental mild climate with a risk of summer droughts. The soil type varies from sand to loam. Winter oilseed rape, faba beans, triticale and barley are grown, plus 15 ha of semi-natural grassland and 100 ha of temporary grassland for silage with perennial ryegrass, timothy, meadow fescue, red clover and white clover. Machinery services are contracted in for harvesting and manure spreading. Björketorp Farm has organic production, with 120 dairy Swedish Red and Holstein cows milked in an automatic milking system with two robots. The average production is 9600 kg of KRAV-certified milk per cow and year. There are also 11 horses.

Björketorp Farm has an interest in being more efficient by adding value to products, instead of extending the farmland area. A passion for ice-cream making led to upscaling of ice-cream production six years ago. This strategy is also a result of a greater ambition; to be able to influence and make a difference through the farm's activities. In the background, there were influences from the previous farming generation, who were dedicated to good management and taking care of all resources. The choice of ice-cream arose from a passion for ice-cream.

Dealing with the authorities was a problem, as it was a slow process and interpretation of regulations was unclear. Increased skill in making the product has been awarding. Contacts and meeting skilled producers of ice-cream have been of great importance.

Detailed description

Homemade ice-cream in many flavours, sold on-farm

On Björketorp Farm, milk from the farm's dairy herd is used for manufacturing ice-cream. Production is driven by an interest in using the farm's products for good food and no artificial ingredients are used. The ice-cream is offered in a great variety of flavours and is sold on-farm, together with milk and some local products. The ice-cream is also delivered to local restaurants and sold at fairs.

The farm maintains close contact with consumers. Numerous groups visit the farm and a great public event is when the cows are let out of the house after winter. The mission is to spread knowledge of farming to a wider audience.

The farmer´s five pieces of advice on how to develop an idea are: Do what you like doing, sell what you want to eat, fill a niche, create good working conditions and cooperate, involve neighbours and be helpful. The farmer emphasises: 'I refuse to do things only for economic reasons. Everything we do has to contribute to the farm and the people working here'.

Results

The economic benefits are important, but also the privilege of working with something you like. The production target has been reached on Björketorp Farm and a full-time employee now works in ice-cream production. This also means that a large number of people visit the farm to buy ice-cream. This indirectly achieves Björketorp Farm´s overall goal – to spread knowledge about agriculture and give more people access to added value in a farm environment.

The passion for the product makes for success. Commitment to making a genuine product, interest in developing it and interest in cooperation and communicating about agriculture on the farm are keys. Visitors are the future customers. And the ice-cream is really tasty! The product fills a niche and the farm is strategically close to a highway.

Adoption criteria

Close to an urban area, sociable and good at ice-cream

Björketorp Farm sells almost all of its ice-cream within the immediate area. This means that there is scope for at least one dairy farm in every community to develop ice-cream production and sales. Of course, on-farm sales require a strategic position close to a large town. It could also be possible to have collaboration between a dairy farm and a business that only produces ice-cream. Product quality is a key issue. Björketorp Farm is highly dedicated to investing in excelling at ice-cream production and has used knowledge and contacts to achieve this goal.

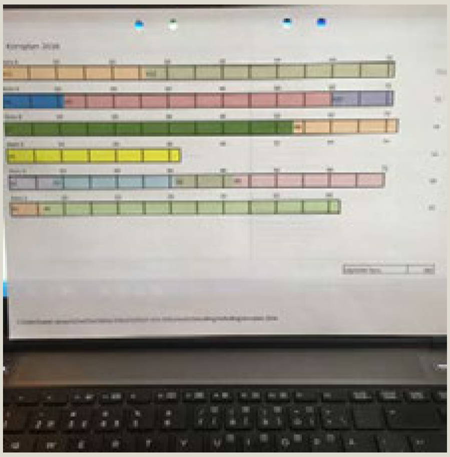
Future prospects

Drive – the key and the pre-condition for development

There is no lack of new ideas about development of the farm. Ice-cream production is part of the desire to develop all of the farm's potential. Ice-cream sales are promoted by all activities that draw in more people. However, the driving force is still to do something good. One idea is to involve the farm's horses in the concept. Another idea is to develop a restaurant and event/party venue. One option is to collaborate with a restaurant that cooks food using raw ingredients from the farm. The farm already hosts study trips, but this can be expanded further.

Many people are important for the success of the enterprise. It is important to employ skilled workers instead of trying to master everything alone. It is also important to have help to move forward. It is a great advantage to have a sounding board, which is regarded as essential on Björketorp Farm. More collaboration will be needed to deal with the future climate: 'If you don't keep swimming all the time, you drift backwards'.

Handy Excel spreadsheet for forage inventory, consumption and production



Farm: **Jon-Jon**
Location: **HÄLSINGLAND (SWEDEN)**

Photo: Linda af Geijersstam
Text: Nilla Nilsdotter-Linde, 2019

Background

Jon-Jon Farm is situated in a region with a cold continental climate close to Bollnäs in Hälsingland, central Sweden, and has sandy to sandy loam soils. There are 160 Holstein milking cows, which produce 12500 kg milk per year in an automatic milking system with two Delaval robots. The heifers are sent out to a 'heifer hotel' on a neighbouring farm. Jon-Jon Farm has 330 ha of productive land (74 ha owned, 256 ha rented), of which 180 ha is temporary grassland cut for silage. Grazing is restricted to 15 ha of exercise pasture. Barley and spring wheat are also grown on the farm.

The leys are sown in pure stands, rather than being undersown, and consist of timothy, festucoid *Festulolium*, meadow fescue, red clover and white clover. The farm has its own tedder and decides when the grass will be moved from the field. The farm hires machinery for harvesting, chopping and filling silo bags, but has own equipment for hay raking and fertiliser and manure spreading.

The farm is very interested in calculating and monitoring to optimise use of farm resources. It has always had a strategy for monitoring cuts, forage analyses and inventory. Improvements have been made continuously. Computerisation revolutionised the system, with Excel spreadsheets being particularly useful. The Excel spreadsheet is used for making decisions, or when an issue arises.

Good monitoring of feedstuffs allows full stocking rates while knowing that there will still be enough feed. In this way, the farm's land can also be utilised optimally. Areas near the farm are used for grass production and land farther away for grain production. This reduces the transport costs on the farmed area.

Detailed description

Marking, documenting and calculating for safe, optimised forage usage

On Jon-Jon Farm, the aim is to optimise silage production. Good quality, frequent forage analyses and skill in optimising animal rations are part of this. Cutting costs by producing all silage in areas close to the farm is also an advantage.

In mapping, an account is made of where silage of different types is situated, the amounts and corresponding silage analysis. The silo bags are also marked every 2 m and at the place where a new load or silage analysis begins. Mapping of silo bags and an Excel spreadsheet on silage use make this possible. By entering the total stock of silage in a spreadsheet, the use can be planned until the next harvest, which can be up to a year ahead. If there is a shortage of forage, then it is possible to reduce the ration or the number of cows. An alternative is to fill a smaller first-cut silo bag to be used in summer. This is an economical method to ensure there is enough silage and makes it possible to avoid excess storage of silage.

Results

Precise use of forage and area and confidence in forage supply

Silage is stored in silo bags and a small number of big bales. An accompanying Excel spreadsheet lists where silage corresponding to a certain forage analysis is situated. As the silage is weighed when mixing, it is also possible to calculate total yield of harvested forage. A good computer-based protocol used with good discipline is the key to success.

The system allows several goals to be met simultaneously, e.g. it is possible to avoid excess storage of silage and the current year's silage can be opened in August. The most important advantage is that it shows whether there will be enough forage. At any time of the year, the farmer can calculate how long the forage will last. The Excel spreadsheet calculates the date on which the forage will run out. With continuous monitoring, it is fully possible to:

- Reduce the amount of forage in the ration
- Reduce the number of animals by culling
- Buy forage from a partner farm
- Make a wetter 'summer silo bag' to complement the forage ratio until the year's silage is opened in August.

Adoption criteria

A system that requires precision

This innovation is suitable for farms actively seeking to optimise their production. The system as a whole requires an interest in calculations in general and calculations using Excel spreadsheets in particular. Storing silage in silo bags is the starting point, as it suits the monitoring system. However, few farms store all their silage in silo bags.

It is also possible to adopt parts of the concept. Marking where forage samples are taken, e.g. where a new batch begins, is easy to do. The feeding-out rate can be checked by noting how many metres of silo bag are used in a certain number of days. This can be used as the basis for other calculations.

To exploit the system to the full, all those involved in production need to be prepared to contribute. During harvesting, it is important that the person responsible for silo packing makes a mark with a pen after every load and also marks where samples have been taken for forage analysis.

Future prospects

Important to involve staff in the process

Jon-Jon Farm uses a monitoring system that has been developed over many years and is practically fully mature. However new ideas or question may arise, in which case the Excel spreadsheets can be used for decision support.

There are also risks in the silo bag system, e.g. filling must function well and the bags must be laid within a limited area and on a good surface. Precision in packing is important.

The farm has long-term employees who have been working on the system for a while, and this helps towards the success of the system. A good contractor does the packing, which is also important. The farm also uses a feeding advisor, who helps to formulate an optimal ration.

Grazing – valuable for more milk and less costs

Farm: **Kårtorp**
Location: **VÄSTERGÖTLAND, SWEDEN**

Photo: Margareta Dahlberg
Text: Nilla Nilsdotter-Linde, 2019

Background

Kårtorp Farm is a 250 ha farm including 130 ha forest, operated by father and son. In addition, 159 ha are rented. The farm lies close to the river Tidan, in a temperate continental climate in south-west Sweden with approximately 700 mm precipitation a year. Most of the arable land can be irrigated, including 110 of temporary grassland used for silage or grazing. There are 39 ha of flooded semi-natural grasslands close to the river and these are rich in grasses, legumes and herbs typical of areas that are flooded for part of the year. The farm receives EU grants through the agri-environment schemes on biodiversity for grazing these semi-natural grasslands. The farmer claims that this grant is crucial in enabling this part of the farm to be grazed with cross-breed heifers and steers (Swedish Red × Charolais).

On Kårtorp Farm, viable forage production has been the focus for many years. On this organic farm, the 210 dairy cows of the Swedish Red breed do a lot of grazing. According to the KRAV certification rules, milking cows have to graze at least 12 hours a day during the grazing season (5 months in this part of the country), graze at least 6 kg DM/day or at least get 50% of their forage from grazing. Therefore, it was important to plan the logistics carefully before farm expansion. There is an automatic milking system with four robots (GEA) and six full-time workers, including the two owners. Kårtorp Farm contracts in much of the machinery services needed for e.g. harrowing, manure spreading and drilling.

Detailed description

When enlarging the farm by another 130 dairy cows in 2009, special effort was devoted to planning for extended grazing. A new house was placed in the middle of the available grasslands, to allow easy access to the paddocks from the parlour. The aim was to keep large milk production with more cows on the existing land area. There were two main targets in achieving this goal:

1. To improve the grazing management to achieve high-yielding pastures with good profitability.
2. To produce a high-quality silage for the dairy cows.

Grazing management is carefully planned on 28 ha of the temporary grassland at Kårtorp Farm. A seed mixture with *Trifolium repens*, *Lolium perenne*, *Poa pratensis* and *Red fescue* is sown at a rate of 20 kg/ha. The cows are let out in April–May. Recently milked cows are let out directly from the robot. Every morning, they are given new grass in a 1.5 ha area and they graze more than12 hours a day for 150 days a year. The stocking rate is 6.25 livestock units per ha and year. An attractive sward encourages the cows to graze. The area is strip-grazed the whole season, i.e. the cows move to another 3 ha paddock every second day. The pasture gets a rest period of 18 days after each defoliation and the total number of defoliations per season is 6.7 per paddock.
The paddocks are fertilised with 30 ton slurry per ha in the autumn, to re-circulate the nutrients and maintain soil fertility. They are also irrigated if necessary, depending on the weather in the actual season.
If the grass grows too fast, a cut of silage is taken. During the summer, the pasture is mown on average three times, to remove overmature and contaminated grass and encourage fresh regrowth.

Production of silage is also crucial for the farm’s finances. All heifers are moved to a 'heifers´ hotel' when they are four months old and are brought back to Kårtorp before calving. The result is that all forage from the 112 ha of temporary grasslands used for silage production to the dairy cows is of high and uniform quality. This is one reason why Kårtorp Farm was the winner of the Swedish Grass Silage Competition in 2018. A seed mixture with *Trifolium pratense*, *Trifolium repens*, *Phleum pratense* and *Lolium perenne* is sown, at a rate of 20 kg/ha. Tall fescue has been tested, but this species thrives best on more than three cuts per year, which is not optimal at Kårtorp Farm. Approximately 13–15 forage samples are taken for analysis per year, both on fresh herbage and in the silage from the three bunker silos. The results of the fresh forage analyses are used to evaluate the effect of the seed mixture and to determine the cutting height (amount of fibre needed) of the whole-crop cereals (*Avena sativa*, *Hordeum vulgare*, *Triticum aestivum*). The silage analyses are the basis for feed optimisation. The feed ration contains a significant proportion of silage and whole-crop cereals (60% of the diet, 13–14 kg DM per cow and day). Additives are only used if the grass is too wet or too dry, and also on the top of the bunker silos.

A new slurry lagoon was built during expansion, so that the slurry can be stored until spring, with better nitrogen efficiency as a result. By application of 60 tonnes slurry per ha, a nitrogen effect of 30 kg N/ha is achieved. Kårtorp Farm also applies 100 kg/ha Kiserit, adding 20 kg sulphur per ha, which is needed to maintain the large yield in organic production. The ability to irrigate most of the land is also essential in maintaining large production.

Results

Through the innovative management system used, the grass production in grazed paddocks delivers 5.0–5.5 tonnes per ha. The cows milk 10400 kg per year, which is very good in organic production. In 2017, the average milk yield for all cows in Sweden was 9760 kg energy-corrected milk. Milk production increases in early season, especially in May and June. To avoid a yield decrease later in the summer, in 2017 the farm started to irrigate not only the cut temporary grasslands but also its grazed pastures. The cost of machinery is approximately 445 Euro per ha and year. About 40% of this cost derives from contract machine services. The total cost for grass silage is 735 Euro per ha and year.

Adoption criteria

It is important to consider planning of house location, grazing paddocks and grassland management at the time of expansion. It is also important to work together to meet common targets. The staff must be positive and know what to do. Finally, monitoring work is important for further improvements.

Future prospects

Grazing management is a challenge in an expanding business. However, skilled grazing management is profitable and important, especially in organic production. Grazing is also essential from a consumer perspective, as the public want to see grazing animals in the landscape. Structured work, cooperation and communication on targets are three driving forces to get high-yielding pastures and good profitability in dairy production based on grazing. There are good possibilities for deeper learning about grazing management from research and from practice, both nationally and internationally. More developed farm advisory services on this issue are also needed.

Intensive forage harvesting system more profitable:
'Three cuts gave better forage quality and better returns'


Farm: **Luttugården**
Location: **NORRBOTTEN, SWEDEN**

Photos: Viktoria Luttu Wahlberg and Linda af Geijersstam
Text: Hulda Wirsén, 2019

Background

Luttugården Farm lies within the Arctic Circle, near Övertorneå in Norrbotten county. The farm has around 65 dairy cows of the Swedish Red breed that produce 11200 kg milk per cow and year. The cows are milked in a robot system and kept in a loose house built in 2004. The farm also rears 100 of its own and bought-in steers for slaughter, in a fattening house built in 2011. The workforce consists of one full-time employee and 1.5 fulltime family members. During the growing season, the farm also hires temporary staff at an hourly rate for some of the field work.

The farm has 258 ha of arable land. It owns only 30 ha of this land, while the remainder is leased. The soils are mainly (2/3 of area) silt-based river valley sediment deposited after the last ice age around 8500 years ago. A considerable proportion (1/3) are also organic (>20% humus), with a high humus content that can reach 60–70% in some fields.

Climate and sunlight

The climate in the region can be defined as cold continental, with annual precipitation of 500–600 mm. A characteristic feature is the long winter, with snow cover for around 200 days per year and average snow depth of 70 cm. Spring tillage usually starts during late May and is completed in June. In winter, the temperature can fall to -40°C, while the maximum temperature in summer can be around 32°C.

Another important factor for crop growth in the region is the long summer days, i.e. many hours of sunlight when the sun does not sink below the horizon during the growing season. Up to 470 sunlight hours have been recorded in Norrbotten county and therefore the grass grows around the clock. The peak solar radiation is equivalent on average to 8000 W/m^2 of global insolation, 13000 W/m^2 of direct insolation and 4000 W/m^2 of diffuse insolation.

Detailed description

The number of forage cuts on the farm has been increased from two to three per year. The seed mix used for grassland consists of timothy, meadow fescue/tall fescue, red clover and sometimes white clover, with timothy as the base (70%). The timothy variety SW Jonatan was used in the past, but has been replaced with Grindstad, which is earlier in its development and produces good regrowth. On Luttugården Farm, it was estimated that a production increase of 200–300 kg milk per cow and year would cover the costs of the extra cut.

Cut timing and storage method

The first cut is generally taken between 18 and 22 June and a careful assessment is made before this. For example, samples are taken for analysis 2–3 weeks before the first cut, the temperature sum is calculated via a decision support tool for grassland forecasting (www.vallprognos.se) and grass growth is monitored. When the timothy reaches the earing stage, a cut is taken. The second cut is taken 5 weeks later and a third cut after an additional 6 weeks. By the time the last cut is taken, the nights have started to get longer again.

All forage is stored in round bales. Since some of the land leased by the farm is far away, this is the most flexible system and has the lowest production costs under the prevailing circumstances.

Crop rotation and seed mix

Only forage is grown on the farm. A four-year crop rotation is applied for temporary grasslands on around 140 ha (Table 1). In addition, there are around 60–70 ha of grazing, including both semi-natural grasslands (44 ha) on shore meadows around the lake and grazed temporary grasslands (around 19 ha) near the farm centre. The remaining area consists of older leys that produce forage for dry cows and heifers and are harvested extensively, in this case 1–2 times per year.

Table 1. Crop rotation for temporary grassland on Luttugården Farm

Year 1	Year 2	Year 3	Year 4
40 ha	40 ha	40 ha	40 ha
Spring wheat + peas, undersown ley	Ley I	Ley II	Ley III

The ley is undersown in a mixture of spring wheat and peas. The seed rate for this crop is usually 150 kg/ha and it is ensiled after harvest and fed together with the forage. On fields with a higher humus content and lower pH, the peas are replaced by vetch and the seed rate is reduced to 100 kg/ha. The insown ley consists of a mixture from Lantmännen that is adapted for northern Sweden (Table 2). The seed rate for this is usually around 23 kg/ha. On soils with very high humus content, alsike clover is sometimes used since red clover has difficulty establishing on these soils. Having white clover in the seed mixture compensates for the decline in red clover during the third ley year, so a few percent are sometimes included in the mixture.

Table 2. Proportions of different forage species used in the ley seed mixture on Luttugården Farm

Seed mixture (species, variety)	Percent, sown (%)
Phleum pratense, Grindstad	78
Festuca pratensis, SW Rewansch	10
Trifolium pratense, SW Yngve	12
(*Trifolium repens – Trifolium hybridum*)	?

Fertilisation plan

Luttugården Farm applies a cropping schedule with planned fertiliser doses. It is now converting to organic and as a result of that is returning to a two-cut system. The fertiliser plan (Table 3) is based on fertilisation in the three-cut system, which is the focus of the innovation, and involves use of the farm's own manure and purchased commercial fertiliser as a complement. No pesticides are used on the farm, even on the conventionally managed area.

Table 3. Nitrogen dose (kg/ha) applied to the three cuts of grassland in ley years I-III on Luttugården Farm

	1st cut	2nd cut	3rd cut
Nitrogen (Ley I)	54	54	27
Nitrogen (Ley II–Ley III)	80	35	27

Results

Milk yield from the farm's cows increased by at least 500 kg per cow and year with the three-cut system, which was more than the amount needed to cover the costs of the extra cut (200–300 kg). For the farm, this meant that in addition to more revenue from the milk itself, it also received a higher production subsidy, since the 'national subsidy' for this area is coupled to milk yield. It has therefore been profitable to intensify the forage harvesting system.

Yield and forage analyses

No direct increase in yield was observed as a result of the extra cut. The forage yield in conventional production was around 5000 kg DM/ha, which corresponds to the average yield level for Norrbotten county. Yield can vary between different farms in the region, depending on their soil type, their position in the landscape and the status of their grassland. Luttugården Farm has fine-textured soils but lies slightly inland and has a large proportion of organic soils, which means that forage yield is reasonably large. However, the quality of the forage improved with three cuts instead of two (Table 4).

Table 4. Nutrient content of forage taken in the two-cut (A) and three-cut (B) system on Luttugården Farm

	Metabolisable energy	Crude protein
Cut	MJ/kg DM	% of DM
1st cut		
A	>11.0	>150
B	>11.0	16.0
2nd cut		
A	10.5	12.0
B	>11.0	16.0
3rd cut		
B	>11.0	16.0

The higher profitability with three cuts confirms findings in field trials at Umeå, which show better profitability in milk production with such a forage harvesting system (Nilsson, 2011). The trials, which ran for three seasons (2006–2008), found that the three-cut system gave larger total yield than the two-cut system, provided that the third cut was delayed (Table 5). Forage quality also improved, which reduced the feed costs per kg of milk produced since the concentration ratio could be reduced. The production per kg milk was also lower in the intensive three-cut system. When the time of the third cut was not delayed, the total yield was greater with two cuts (Gunnarsson *et al.*, 2014).

Table 5. Mean forage yield and quality recorded in a three-year trial on different forage harvesting systems at Umeå, Sweden. A = 2 cuts (early 1st cut), B = 3 cuts, C = 2 cuts (late 1st cut) (Nilsson et al., 2011)

Cut	Yield	Metabolisable energy	Crude protein	NDF
Harvesting system	kg DM/ha	MJ/kg DM	% of DM	% of DM
1st cut				
A	2859	11.0	15.6	49.0
B	2970	11.2	14.3	51.5
C	4300	10.8	12.3	52.7
2nd cut				
A	4311	10.3	12.8	49.1
B	3350	10.8	12.8	47.7
C	4515	10.3	11.0	50.7
3rd cut				
B	2786	10.4	14.1	50.6
Total yield				
A	7171			
B	9110			
C	8815			

Adoption criteria

If three cuts instead of two work well at this high latitude, they can work everywhere, as long as the ley consists of species capable of fast growth in all cuts. Recent climate change has also improved the conditions for three cuts per season.

Future prospects

Climate change will mean a longer growing season for the northern hemisphere. Already the growing season is around two weeks longer for farmers in northern Sweden. This should result in more farmers deciding to convert to a more intensive forage harvesting system in future. The autumns have become milder and the grass grows for a longer period, so in order to decrease the risk of winter kill by fungi under the snow, the timing of the last forage cut of the season is important.

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Irrigation and slurry are important resources in dry areas

Farm: **Siglajvs**
Location: **GOTLAND, SWEDEN**

Photo: Margareta Dahlberg
Text: Anna Carlsson, 2019

Background

Siglajvs Farm lies in När in southern Gotland and has 50 dairy cows. It has been producing organic milk since 2009. The aims are to make best use of the farm's resources, to produce food in an environmentally friendly way and to achieve large production from cows, grassland and pastures. The organic cows on the farm produce as much milk as conventional cows, with yield of around 11000 kg per cow and year. The extremely hot, dry weather in spring 2018 had an effect on the farm and temporarily decreased the level of milk production. Gotland is a limestone-rich island and has annual rainfall of only 500 mm per year, making it one of the driest parts of Sweden. Another major problem for farmers on the island is the high population of barnacle geese, which graze the fields in the spring and severely reduce grass growth.

Detailed description

Siglajvs Farm lies in an agricultural area, but the entire island of Gotland has a high level of tourism, particularly in summer. This can affect how agriculture is developed and expanded. When Siglajvs Farm was converting to organic milk production, the dry climate was considered to be a major risk. The farm lies very close to the Baltic Sea, which has a relatively low salt content, and in the past the water was used to irrigate sugar beets and meadows. However, problems arose with this irrigation, while tractor-driven irrigation pumps were too expensive. Therefore, together with another farm, Siglajvs Farm designed and built a 16 ha irrigation dam, which was completed in 2006. Water is pumped into the dam in autumn, winter and spring from a canal draining 35 km^2 of arable land. The intention is for nitrogen and phosphorus to sediment in the dam, thereby reducing the nutrient load reaching the Baltic Sea.

Siglajvs Farm wanted to achieve more, however. Thus in 2009 they applied for a grant for an irrigation company, Närstream, which was created by three farms. It has installed 40 km of irrigation pipe, e.g. to a nearby golf course that also needs water. Two pumps maintain the pressure in the pipes and in the high season eight irrigation machines and the golf course's irrigation system are in use. The irrigation company has three irrigation machines and Siglajvs Farm also owns one. Apart from irrigating the farms' own land, Närstream sells irrigation services to other farmers. A lot of potatoes are grown on Gotland, often in dry periods, so potato growers need to have access to irrigation. Siglajvs Farm waters its own grassland early in the season and is therefore able to sell irrigation to its neighbours later on. At home, they often water the grassland a week before the first silage cut, which is taken at the end of May, to ensure that the grass can start regrowth quickly after cutting. They often apply 20 ton/ha slurry after the cut, and then 20–25 mm of irrigation.

Another environmental measure taken on the farm was to build an extra slurry lagoon with a roof. This means that they can store the slurry for spreading in spring and summer and get better nutrient utilisation and larger yield. The roof prevents rainwater entering and diluting the slurry, which decreases the volume that needs to be spread.

Barnacle geese are a protected species on Gotland. Culling is only allowed in spring and only five geese may be shot on the farm. However, the geese are present in their thousands and graze and foul the grassland. Through observation, Siglajvs Farm has identified grass and legume species that the geese prefer/avoid. Thus the conventional cocksfoot has been replaced by tall fescue hybrids, while among the legumes lucerne has been found to be least grazed by the geese. However, it is also considered important to include other species, apart from grasses and legumes, in the sward. Of these, caraway copes best with the geese. The county council has helped with the cost of forage analyses for the different seed mixtures.

Another important strategy as regards feeding on Siglajvs Farm is to grow as much protein feed as possible. They now grow a vetch-spring wheat mix for whole-crop silage. This gives more protein than the pea-oats mix that was grown previously. The protein mix crop is sown in spring, together with an undersown grass ley. By the end of July, the vetch has developed sufficiently and the wheat has reached the milk development stage. The crop is then cut with a mower conditioner and harvested with ordinary grassland machinery. The ley continues to develop afterwards.

Apart from the dairy cows, Siglajvs Farm also has 50 ewes of the Gotland breed. The farm's natural pastures are grazed by these sheep and by calves in alternate years. This results in parasite-free grazing, so no worming treatments are needed for the animals. In winter, the heifers get the feed that the sheep separate out, since they are more selective in their feeding. This means that there is no loss of feed.

Results

Since Siglajvs Farm collaborates with its neighbours, the yield of the different farms can be compared. In the first cut, Siglajvs Farm's organic leys give the same yield as the conventional leys of neighbouring farms. However, yield is lower in the other cuts.

The change to storing slurry under cover reduced the spreading costs by 500 Euro per year.

With the new forage seed mixtures that are less attractive to barnacle geese, it has been found that the harvesting window is narrower. In both lucerne and tall fescue, the nutrient content decreases rapidly if the crop is not cut often enough. Fortunately, these species have a similar development rhythm and are therefore a suitable combination. They are also tolerant to drought, since they are both deep-rooting. The herbs included in the sward, currently caraway, chicory and pimpernel, also have a well-developed root system. Ribwort plantain is not as deep-rooting, but appears to be very tolerant to drought.

Siglajvs Farm has chosen to use its existing buildings and land to the optimum, since the alternative of increasing its area and herd size is not realistic. When the farm converted to organic, milk yield decreased by 1000 kg per cow, but is now around 11000 kg per cow and year. Conversion to organic brought other benefits: less concentrate, more forage and positive effects with healthier cows.

Adoption criteria

Year 2018 was one of the driest years in Swedish history. Many farms are now considering creating irrigation ponds or dams so that they can water their crops in future dry years. Collaborating with neighbouring farmers to create an irrigation company also brings benefits to others in the community and a large environmental dam collects leached nutrients that would otherwise be transported along drains to the Baltic Sea. It is both financially and environmentally sound to retain as much nutrients as possible on the farm, by e.g. building a roof over the slurry lagoon and only spreading slurry in spring or summer, when growing plants can take up the nutrients. This also increases the yield of the crops. Testing which crops are best suited to the specific farm is important for success. On Siglajvs Farm, this has led to use of a vetch-winter wheat mixture for production of protein-rich whole-crop silage. The farm has also adjusted its seed mixture composition to reduce damage by grazing barnacle geese.

Future prospects

The investments made on the farm were partly funded by grants. However, such grants come with a range of conditions and there is a risk of non-payment if these are not fulfilled. In addition, the application process is demanding for the farmer, but at the same time the amounts of capital involved are great and the grants are important.

Last year, Siglajvs Farm tested drilling cereals with GPS. This meant that they could carry out an extra hoeing to control weeds. The results were good and, despite the dry summer, the yield was 3.5 ton per ha. The farm intends to continue with this system. By working with a holistic approach, the aim is to continue improving the environmental profile of the farm.

Simple system for better rotational grazing for heifers and young steers


Farm: **Skogsgård**
Location: **HALLAND, SWEDEN**

Photos: Linda af Geijersstam & Anna Carlsson
Text: Anna Carlsson, 2019

Background

Skogsgård Farm, which is located in Getinge in south-west Sweden, has an organic dairy unit with 240 cows. The farm converted to organic in 1995 and since then it has refined its grazing system to get more milk and animal growth from its grassland. In the surrounding region there are many active farms and it is difficult to get arable land. When the farm needed more arable acreage 20 years ago, the only option was to lease land 25 km away, in an area where the plains landscape transitions to forest. The farms there are smaller, with a few dozen hectares of arable, permanent pasture and some forest. These farms tend to have stopped livestock production, but still want their fields kept open by grazing. Skogsgård Farm leases 30 ha of temporary grassland and semi-natural grassland in the area, which are grazed by the farm’s young stock. Day-to-day supervision of these animals is carried out by the nearby land owners, while transport of animals and other management of the land are carried out by Skogsgård Farm itself.

Detailed description

The dairy cows have a well-managed paddock system that gives large yield and high quality. This requires the cows to be moved once or twice a day. For the young stock grazing the leased fields farther away, a simpler system that still gives good quality and quantity is applied. The young stock were originally kept on 2–3 paddocks and moved between these, but this has now been increased to four paddocks. These animals graze a paddock for a week before being moved to the next, so there is a three-week interval between grazings on each paddock. The optimal approach for both quality and quantity is to graze the grass at the three-leaf stage. In summer, it takes around a week for each leaf to develop, so the growth rhythm of the grass matches the paddock rotation. In spring, when growth is fast and leaf development is faster than a leaf a week, it is difficult for the grazing animals to keep up. Half of the young stock are let out on grazing early, in April, when growth is slow. If necessary, they receive a supplement of round bale silage. The animals are happier with such supplementary feeding in spring than in autumn. The animals are moved to a new paddock every week. The remaining animals are let out around 'magic day', the time when their feed requirements match the growth rate of the grassland. After this, the animals are moved between the four paddocks on a weekly basis. When the grass is growing too fast for the young stock to keep up, different measures are undertaken. One is to introduce more animals to increase the grazing pressure. Another is to set aside a paddock for forage harvesting. This forage can be used for supplementary feeding at a later date. When the grazing pressure becomes too high, some animals can be taken off. In August, grass growth usually starts to decline and then around half the animals are removed and put to grazing regrowth or forage crops such as stubble turnips, fodder rape or swedes.

The animals are supplied with water by a pipeline at a point when several paddocks meet. This 'square' has several entrances to the different paddocks, to reduce trampling damage.

Results

By increasing the number of paddocks and improving the infrastructure, Skogsgård Farm has managed to increase its grassland utilisation with a reasonable labour input, despite the grazing land being far from the main farm. It is now possible to keep more young stock on the same area and still get better growth per animal. Compensatory growth means that these animals can increase in weight when they are moved to a new paddock. It is now easier to see when a paddock is fully grazed, sine the young stock are kept on a smaller area. The more intensive grazing has also affected to composition of the sward. In some fields that are not grazed sufficiently well, soft-rush tends to grow in wet patches. When the young animals graze hard they also graze the soft-rush and after only a year there is a marked reduction in its incidence. The same applies to dock plants. This version of paddock grazing increases the yield and quality of the grass and reduces the labour requirement for moving animals.

Adoption criteria

This system works well for those wishing to change from continuous grazing to paddock grazing or wishing to increase the intensity and structure of their paddock grazing. It is a way to make grass last longer. The lower intensity compared with conventional rotational grazing means that it is suitable for those farmers who do not wish to move their animals as often. The paddocks also lead to more complete grazing and less need for mowing, and therefore better managed grazing. With the one-week system, it is easier to monitor grass growth rate by visual observations and take action, e.g. alter the grazing intensity or harvest the forage.

Future prospects

The grassland in Sjöred, where the young stock is kept, is mainly located on very light soils that are susceptible to drought. However, there is a lot of rainfall in the area so the grass often copes very well. Year 2018 was an extremely hot, dry year, so the grassland scorched and became completely brown. Most of the young stock had to be moved to other fields. This led to an idea that can be tested: by increasing the number of paddocks from four to five, it may be possible to create a buffer of grazing. In spring and early summer the young stock could be moved every 5 days. This would mean grazing at 2.5 leaf stage and getting a more immature forage with higher quality. If it appears that the animals cannot keep up with grass growth, they can miss out a paddock, which is left ungrazed. The quality of the grass will decline in that paddock, but it can be strip-grazed in the event of drought or later in the year when grass growth is declining. The extra forage will then extend the number of rotation days and, hopefully, the number of grazing days. Letting the grass heading will also result in natural re-seeding and restoration of the sward. Different paddocks can be set aside in different years. This system would also work well for semi-natural grassland with high nature values.

Maximum grassland use by controlled calving

Farm: **Stommen**
Location: **HALLAND, SWEDEN**

Photo: Linda af Geijersstam
Text: Anna Carlsson, 2019

Background

Stommen Farm in Köinge, which has 85 organic dairy cows, lies in a region of south-west Sweden with a mild climate and average rainfall of 1200 mm per year. The farm has been organically managed for the past two decades and had been extended with land that was previously leased from the church. Optimal use of grassland is the key to successful farm finances, organic production and running the farm with the limited labour available. The goal is to develop a financially robust system.

Detailed description

Maximum use of resources is the goal on Stommen Farm. Grazing is fundamental in organic milk production. The farmer controls calving to obtain the maximum number of grazing animals in spring and to have the cows milking in the right phase to use pasture optimally. The aim is to have only autumn calving, between 1 October and 15 January. Heifers and purebred cows calve first, to get recruitment heifers started early. It is optimal for the main cows to calve by 15 November, at which time they have been grazed dry for two months and the newly calved heifers have acclimated to the milking routine. Cull cows are removed in December, but are milked until then. Between 1 January and 1 August, the barn or the grazing is at full capacity. During the first months of lactation the cows are in the barn, while they are farther along the lactation curve when they start grazing. There is often a dip in grass production in July, at which time the farmer used to provide extra silage so that the cows did not lose too much milk. He no longer does this.

With autumn calving, the work is distributed more evenly over the year. In autumn and winter there is more work in the dairy barn, with calving and then insemination up to 15 April. In spring–summer, the farmer 'only' has to milk the cows and then let them out to graze. Spring tillage, following by forage harvesting, means more outdoor work at that time. The farm has one employee and the intention is for her and the farmer to be able to take time off for holidays in the summer.

Recruitment heifers (20–30), which are born in October, are six months old when they are let out on grazing for the first time. At that age, they are old enough to thrive well on grazing without supplementary concentrate. They calve at 24 months and the farmer expects these heifers to spend 11 months out on grazing before their first calving. Compared with a heifer born in April, which will spend 3 months out before calving, this is a major difference, especially since the Stommen Farm leases an barn from a neighbour for rearing the heifers.

In August–September, the cows are dried off and allowed to graze the regrowth on the temporary grassland. Since they do not need to be brought in for milking, the degree of trampling decreases. Autumn is often a difficult period in this regard, as it generally gets more rain. On the other hand, it is very advantageous to have the cows grazing then. The aim is to keep them out on grazing until 20 October.

It is important to keep grassland management simple, to avoid missing the growth potential. The cows are let out on grazing in the middle of April in order to encourage tillering of the grass and keep the growth under control so that the quality does not decline. When the milk level in the tank starts rising, the cows are put on 24-h grazing and indoor feeding ceases. The current aim is to change paddock twice a day during the summer. The farmer assesses grass growth by walking the fields once a week to monitor development. Sometimes, he clips some samples to determine herbage biomass and dry matter content. It is encouraging to see that growth doubles every week at the peak of the season, to reach a maximum growth rate of 1600 kg dry matter/ha. It is also important to take to decision to harvest forage for silage when growth exceeds 1600 kg dry matter/ha. The farm does not have much machinery, but it is important to have a mower for topping individual paddocks when the grass growth is high or to control some weeds, e.g. docks.

Results

In the organic production system on the farm, grazing gives a good financial return. Access to labour determines how farm work must be distributed throughout the year. On Stommen Farm, the concentrated calving is an advantage. It is also an advantage to have an empty calf house so that it can be sanitised properly, resulting in healthier calves.

The key factor is for the grassland to produce as much as possible and to keep enough animals to exploit this forage production. In the past grazing season, the cows on Stommen Farm produced 250 tons of milk in six months. This is equivalent to 1816 Euro per ha.

Adoption criteria

The innovation works best as a way to use the labour available on a particular farm. Concentrated calving results in a peak in labour requirement in late autumn, but a lower requirement at other times of the year. The system levels out the peak workloads between summer and winter.

Organic production is the key to profitability in the system. Having highly valuable forage means that the profit from optimising production is greater. With more grazing, the need for owning machinery decreases. Contract machinery is an advantage in this regard.

Of course, having grazing as the cornerstone requires a farm to have good natural conditions for grassland. Stommen Farm’s location in western Sweden, with normally good rainfall and water-retaining soils, is important. Good farm layout is also an advantage. Overall, however, the farmer must be very interested in grassland management for this system to work. Stommen Farm has a tried and tested system of paddock grazing and timing, with complementary mowing.

Future prospects

Streamlining the system is a constant ambition and driving force. Water supply to the animals is a practical issue that is still being improved. The aim is to have water in every paddock, to avoid the need to drive out with tankers. The farmer is striving to achieve simplicity in the system. Professional advice on grazing management is always needed.

Coordinating with nature in this way requires constant vigilance. It involves matching growth with production and not letting it run out of control from that 'magic day' when everything starts to grow. Interest and monitoring are important for success.

Monitoring the amount and quality of silage in tower silos

Farm: **Valinge**
Location: **HALLAND, SWEDEN**

Photos: Bernt Bengtsson & Linda af Geijersstam
Text: Anna Carlsson, 2019

Background

Valinge Farm is run by three brothers and comprises a number of smaller farms with dairy, sheep and piglet units. The original farm with the dairy unit is located at Valinge, near Varberg in south-west Sweden. It has a herd of 105 cows, of both Holstein and Swedish Red breeds. The other farms have a piglet production unit with 140 sows, a sheep herd of 50 ewes and replacement heifers. In total, the farm has 250 ha of arable land and 15 ha of permanent pasture, which is grazed by the sheep and heifers. For years, the brothers have been involved in monitoring and improving their production. A deep interest in good forage is a strong driving force on the farm. The brothers derive great benefit from analysis of their forage batches, which allows them to optimise rations and to check that there is enough feed. Repeated forage analyses provide a good basis for formulating diets. The farm uses its own grass seed mix. The brothers were named Swedish Grass-land Farmer of the Year in 2013. Year after year, they achieve uniformly high milk production.

Detailed description

Most of the farm's maize and silage is stored in tower silos. When the material is loaded into the silo, the number of loads is recorded and a numbered plastic plaque is placed after every five loads. These plaques turn up later in the feed. A different colour is used for each of the farm's three silos and the plaques have up to three large holes, each of which indicates 50, and small holes, each of which indicates five. This system provides an indication of how fast the forage is being used. This is difficult to determine otherwise, since there is much more feed in the densely packed lower layers in the silo. It is important to know what forage is available and whether there will be enough. At harvest, a grass sample is taken for every field (around 10 ha) and sent off for analysis. There are usually six samples analysed per cut of forage. Recording the field from which the load originates makes it possible to monitor exactly which field the silage comes from.

The harvesting strategy aims at grass forage with 11.5–12 MJ energy, 160 g crude protein and 470–480 g NDF per kg dry matter. Three important conditions allow this aim to be achieved:

1. The first cut must be taken in time. If it is immature, with lower NDF, more maize is added to the diet.
2. The second cut must be taken 4 weeks after the first. The third cut is taken after an additional 4–4.5 weeks and the fourth cut after a further 6–7 weeks.
3. The grass seed mixture used is well suited to conditions on the farm.

Results

Interest in making maximum use of the forage grown on the farm is key to the success of the system. When the results of the forage analysis are available, the farmer formulates a diet for the dairy cows based on the actual batch being taken from the tower silo. He then monitors the results when the cows start eating the silage, in terms of milk yield, milk fat and protein content and urea in the bulk tank. If necessary, he adjusts the diet. The cows are fed a daily feed mix that is intended to enable them to produce 35 kg of milk. Of this mix, 85% is grown on-farm. The cows also receive a ration of complementary concentrate in feed troughs, on which they are intended to yield up to 50 kg of milk. If the milk yield is higher, they eat more of the forage mix. The brothers who run Valinge Farm have found that this system works best for their cows and they do not want to feed more concentrate. At present, the cows produce 12800 kg milk per year. In general, the fresh forage analysis is accurate, but occasionally a complementary analysis is made on the silage. However, this is more of a retrospective check, as the silage is usually eaten before the results arrive.

'A grass seed mixture is never set in stone', according to the brothers on Valinge Farm. They test different species to see whether they fit into the system. The leys lie for three years. When tall fescue is present in the sward, there is more variation between batches and quality checks are even more important. When tall fescues were first tested on the farm, the variety Hykor was used and it was found that it lost its feed value if it was not harvested often enough. After a few years they changed from Hykor to Karolina, which is a few days later in development. This means that it is easier to take cuts before the feed value starts to decline. The farm is in south-west Sweden, where it is rather rainy in summer, so it is important to find a few dry days for forage harvesting. The farm has its own silage harvesting equipment, instead of relying on contractors, so it can ensure that the optimal harvesting time is exploited. Samples of grain are also sent for analysis, but it has been found that the quality does not differ as much between years in that case. Samples are usually taken from each type of cereal.

Adoption criteria

On Valinge Farm, they believe that their system of recording the loads that come from different fields can also be applied in a round bale system. In that case, the bales could be labelled or placed in order of feeding. The advantage of analysing the fresh forage is that the results are available when it is time to start feeding the silage and the diet can be formulated directly.

Future prospects

Sometimes the results of the forage analysis are not consistent with the milk yield. The first cut is often better than it appears on paper. 2018 was a very dry year, with smaller forage yields. By growing much of the feed themselves and also growing extra cereal for sale, Valinge Farm is able to cope with such fluctuations.

Ed Payne- Setting Up a Dairy Farm for Grazing

Farm: **Ed Payne**
Location: **Tulsk, Co. Roscommon, Ireland**

Background

The history on this farm is one of suckler, beef and sheep farming. In 2009 we made the decision to convert the farm to a dairy enterprise. Today myself (Ed), my wife (Jennifer), my Dad (Jimmy), my mother (Dawn), Manager (Aidan) and extended staff run the farm. Jennifer and I have two young boys, Ben (6) and Aaron (1). We are currently milking 450 cows in two milking platforms supplying our milk to Aurivo Co-op.

Detailed description

We started milking on this farm here in Tulsk in spring of 2011. It is set on an 80ha grazing platform of which 58ha is owned and 22ha is leased. We currently milk 300 cows here with plans to expand this to 320 cows as our grass utilization figures increase.

The cow type on our farms is high EBI and approximately 35% crossbred; we have been breeding for EBI since we started milking and have seen huge benefits in doing so. The future of the herd is to continue breeding for high EBI while we also intend on increasing the level of crossbred animals in the herd and as a result reducing the average weight and size of the herd.

The second milking platform in Ballymoe was developed in 2017 and is now running 150 cows on the 58ha owned block with plans the to go to 200 cows when the reseeding and soil fertility programme is finished. This is a once a day milking platform for various reasons, none more than trying to reduce overall workload on the farm. We as a family wanted to send as many Kgs of milk solids from this farm as simple and economically as possible. The cows on that farm are mainly the later calvers and lower SCC cows, there are little or no heifers milked on that farm.

None of this expansion past, present or future would be possible without a good strong team of people to drive the business toward its goal. At the moment aside from family labour we work with two full time employees Aidan and Kevin, one of whom is not from a farming background, the other left a career off farm to come work with us. Temporary help throughout the year and our contractors are also key to reducing workload and allow for smoother running of the farm. This in turn allows us to always keep an eye on the future expansion plans of the business.

Results

Improved grassland management has unlocked the potential of not only our land but our cows and people also. We would like to thank our Teagasc advisor Seamus Nolan who has been a rock of sense to us over the years as well as running the local discussion group which Aidan, Kevin and I participate in. We are very grateful to have been awarded this prize as Northern Grassland Farmer of the Year 2017.

Adoption criteria

Grassland management has become a key driver to the business over the past few years since we were exposed to it through our local Teagasc discussion group. We have been aggressively reseeding as much land as we can each year be that on silage or grazing blocks. Soil samples are taken on milking platforms every year and all other land every second year. We measure more than 40 times per year and try to put together as much data as we can to help us grow and utilize more grass.

Future prospects

Our aim is to produce milk from grass. We want to minimize supplementation levels on our farm. The more grass we can include in the diet, the less the cost of production in our dairy enterprise. We hope to be sustainable financially, socially and environmentally going forward.

Eddie O'Donnell- Grassland Innovation: Setting Up 2 Milking Units for Grazing

Farm: **Eddie O'Donnell**
Location: **Golden, Co. Tipperary, Ireland**

Background

The Mission statement of our farm business is as follows: “To run a highly efficient, profitable and sustainable dairy business while also enjoying a good family life”.

I am farming with my wife Fiona and parents Denis and Nora, near Golden, Co. Tipperary. Fiona and I have three children - Muireann (4), Meabh (2) and Eddie (7 months). We milked 318 cows in 2017, supplying milk to Dairygold Co-op and Kerry Group, and we currently farm a total of 160 hectares. We are operating from 2 milking parlours since 2006.

116 ha of our land holding relates to our two milking platforms split as follows:

• 74 adjusted ha: Home Farm (43 owned, 31 leased)

• 42 adjusted ha: Out Farm (all leased and located 6 miles from home farm).

The remaining 44 ha are divided into two blocks as follows:

• 20 adjusted ha: (All owned and located 12 miles from Home Farm)

• 24 adjusted ha: (4 owned, 20 Leased and located 2 miles from Home Farm)

These farms are used predominantly for grazing the replacements and for silage production.

We have two employees, Jeremy Furlong and Philip Roche. Philip works on the home farm with me, while Jeremy runs the out farm milking platform.

Having grown up on a dairy and beef farm enterprise, I was passionate about farming from an early age, and I never considered any other career choice apart from farming. After finishing secondary school in 2000, I went to Rockwell Agricultural College for one year to complete my Certificate in Agriculture. I subsequently achieved my Certificate in Farming in Pallaskenry Agricultural College. As part of my studies, I completed my practical placement through the Farm Relief Services. From 2002 to 2005, I managed a 90 cow farm located six miles from home. Having gained good experience from my time away, I returned home to set up a partnership with my parents in late 2005.

I travelled to New Zealand in August 2005 with a number of experienced progressive farmers and researchers from Moorepark. This trip proved to be very beneficial in my development and opened my mind to the vast array of opportunities that exist. Also as a result of this trip, my parents and I began to complete our five year farm plans, which we continue to review and revise annually. This planning has been the catalyst of our significant farm growth to date (50 ha and 70 milking cows in 2005 vs 160 ha and 318 milking cows in 2017).

Detailed description

Grassland

Grassland management for us is based around a number of cornerstones; soil fertility, re-seeding, infrastructure, grass measurement and management.

Soil fertility

It is an essential part of grassland farming to have the correct pH and have the soil index for P and K at index 3 or 4, so for this reason we soil sample the farm every two years and this helps us keep on top of what changes are occurring. We have noticed K levels dropping off in paddocks that are removed for surplus bales so we try and avoid taking bales or silage off lower K index paddocks. We put a fertiliser plan in place annually, and stick to it by spreading fertiliser when it has to be spread and spreading the right amount of it. We have colour coded maps up in the dairy which indicate

the soil index of the paddocks so we can target more parlour washings and slurry to the lower ones, and this map also helps us avoid taking bales from them by making sure the cows hit those paddocks at the correct pre grazing yield thus leaving at the right post-grazing height.

Reseeding

We have re-seeded all the milking platform and one of the young stock farms over the past seven years. We select the paddocks for re-seeding from the cumulative growth chart on PastureBase Ireland at the end of the year, and we aim to do our re-seeding in spring time as we find this the quickest turnaround time with the least risk. We are part of the grass variety monoculture trial in Moorepark and have set all monocultures on the milking platform over the past five years and three way mixes on the out farm. We have many different varieties across the farm.

Infrastructure

There is no point in growing lots of grass if it can’t be consumed by the cow. We have put in extra roadways and extra water tanks on the farms over the last five years. As cow numbers have increased demand for water obviously increased, so we had to install bigger piping from the yard and extra tanks in the paddocks. The infrastructure plays a big part in grass utilisation especially in spring by helping us get out at almost every milking from when cows start to calve. We also use reels to create single file spurs off these roadways at the shoulders of the year to get the cows in and out of paddocks if conditions are wet.

Grass measurement

We began grass measuring on the farm in 2004. We walk the farm weekly during the grazing season and twice weekly during the main season when growth is high. There are several reasons for grass measuring. We aim to use grass well, we need to know how much we have, it gives us higher milk solids, it helps to lower the cost of milk production, and ease of management in a simple system. As we know what the farm is growing we can establish the correct stocking rate for our farm. It also identifies underperforming paddocks and we can predict when a surplus or a deficit is arising which helps us to avoid wasting grass by keeping the quality of grass in front of the cow consistent. We will complete up to 50 walks on PastureBase Ireland this year. Everyone on the farm can complete a grass cover, the most important part of the process is the decisions that are made from producing the grass

wedge or average farm cover figure on the shoulders.

Management

The management is all about timing on our farm, we have set cover targets for different stages of the year, e.g. Closing farm cover of 700 kg DM/ha on December 1st. We have targets for percentage of the farm grazed in spring and autumn, we want to start the second rotation on April 1st in order to do that we require 40% of the farm grazed March 1st to have enough paddocks growing back for April 1st. A week can make a big difference on a grass based farm from running into a surplus or into deficit quickly so when you have information one needs to react by pulling out surplus or putting

in supplement depending on the situation. We had over 10 grazings per paddock and one silage cut in 2017, and the only way our farm can do this is by having a number of 16-18 day rotations during the main season.

Results

Our farm jigsaw is simply made up of three critical pieces - grass, people and cows. There is nothing fancy to what we do, but what we do we try to do right, and to make sure that we review and set achievable targets for ourselves. A consistent approach to grassland management, as well as having the right team of people working with us, has always been and will continue to be a pivotal part of our business strategy. The importance of choosing the correct type of cow for our farming enterprise cannot be underestimated. We feel that we are not doing many things differently to most farmers. I'd like to thank our Teagasc Advisor Sandra Hayes who is always there if we have a question or query on anything. Discussion groups play a big part on our farm and we're involved in four of them, and we try to learn something through all of them. We are very lucky in Ireland to have a world class facility in Moorepark demonstrating and researching best practice.

In summary:

- Grassland production on the farm was 18.6 t DM/ha with 10 grazings
- and one silage cut per paddock in 2017
- 50 grass walks were completed on the farm last year, this is crucial to
- our grassland management
- Soil fertility is at index 4 for P and index 3 for K, soil pH is 5.9
- During the mid-season we try to match grass supply with grass demand
- We will continue to reduce the variation in DM production between
- paddocks, with better soil fertility and re-seeding the lower producing
- paddocks.
- We will not increase the number of grazings from the farm by reducing
- pre-grazing yields any further than where we are now.

Overall the last five years this farm has produced, on average, 17.6 t DM/ha, so the farm has huge capacity to grow. Our job is really to manage what is growing and to make sure that we utilise it as grazed grass. So in the past number of years we have focussed more and more on getting more grazings from the paddocks, increasing paddock grazings will reduce the level of silage harvested on the milking block, and we really don't cut any silage off the grazing platform. Given our stocking rate it makes it difficult to cut main silage cuts, so the strategy is to take surpluses off as round bale silage.

Spring grazing

In general, we start grazing from early February (first week), ground conditions on this farm are usually not limiting so we can send the cows to grass as they calve. In recent years we have been trying to lift the opening farm cover to >900 kg DM/ha at turnout, the compactness of calving and higher stocking rate is pushing us in that direction. Given that we have two farms working, we generally try to have a higher cover here in the Golden mfarm, ultimately because we calve all the cows at home, the Golden farm takes more grazing in February than the Dundrum farm. The spring grazing target is to have 40% grazed by March 1st, this has been difficult this year with grazing conditions (snow and rainfall).

We are now getting to the magic figure of 10 grazings on the farm with one silage cut. As I said previously this would not be possible without having shorter rotations in the mid-season, but also our focus to finish the first rotation early in April. We are usually well into the third rotation by May 1st in a normal year. The number of grazings per paddock is a great way of profiling the performance of the paddocks from a grazing perpective.

Mid-season

The daily grass demand on the farm mid-season is approximately 68 kg DM/ ha (4 cows/ha . 17 kg daily herbage allowance), so we aim to keep grass supply as consistent as possible, the farm is walked regularly which keeps us on our guard to monitor grass supply. We have no problem taking rotation length down to 16 days mid-season and this has helped us increase the number of grazings per paddock. We have a target of 160 kg DM/cow during this period, our mid-season growth rate helps us to achieve this. We don't top paddocks on the farm, we try to let the cows graze at the appropriate pre-grazing yields and this helps to keep topping out of the equation. If a paddock is badly grazed we will earmark it for round bale silage on the next round. Our grazing regime is to graze to on average to 4 cm during the season.

Autumn

Generally in autumn, we build to pre-grazing covers of 2000 kg DM/ha, we find it hard to go beyond that with the grazing platform stocking rate, so 350-400 kg DM/cow is our target in mid-September. We try to start closing in early October and will aim for 70% closed by the end of the first week of November. We have to have grass on the farm at turnout and will be aiming for higher spring turnout covers given this spring.

Adoption criteria

Grassland management has become a key driver to the business over the past few years since we were exposed to it through our local Teagasc discussion group. We have been aggressively reseeding as much land as we can each year be that on silage or grazing blocks. Soil samples are taken on milking platforms every year and all other land every second year. We measure more than 40 times per year and try to put together as much data as we can to help us grow and utilize more grass.

Future prospects

We have worked very hard over the past number of years on increasing grass DM production on individual paddocks. Focussing on our soil fertility to improve this has been essential; we now have a reasonably good soil fertility profile across the farm, soil pH 5.9 (range 6.2 – 5.6), (we have spread 700 t of lime since August 2017), soil K - 131 mg/l (range 65 – 206 mg/l), soil P - 9.7 mg/l (range 4.2 - 26.1 mg/l). We don't cut bales from paddocks with low K. Each year we will look at the individual paddock performance and see what paddocks are doing well, especially from a grazing viewpoint. The farm is targeting more grazings, but we don't want to drop pre-grazing yields any further than where they are, the year average is 1,700 kg DM/ha, but mid season we are going into covers of 1200-1400 kg DM/ha. We want varieties that have good graze out, so far this focus hasn't compromised DM production. Tetraploids have worked well here and we have no problem grazing 100% tetraploid on the farm. Figure 3 (and Table 1) shows the DM production of individual paddocks for 2017. We will continue to try and minimise the variation in DM production between paddocks and will continue to re-seed the lower performing paddocks. Measuring grass is the basis for this decision making; having this data built up over years is now beginning to position us better as a grassland farm.

Ger Dineen: Grass-Measuring Using the Grasshopper and PastureBase Ireland

Farm: Ger Dineen
Location: **Macroom, Co. Cork**

Background

I am married to Gobnait and have four children, Muireann, Ciara, Danial and Ciaran. I also wish to acknowledgethe support over the years of my wife Gobnait and the continued help of my children who have always lent a hand when required. I have around 60 suckler cows and finish the bulls under 16 months with surplus heifers sold for breeding. AI is carried out on all my cows, which I do myself, and keep around 20% for replacements. All cows and heifers are bred to high index maternal sires. I am using Simmental, Saler, Angus, Limousin and this year, Shorthorn. I am also using Fleckvieh and Simmental for more milk.

I farm around 50 hectares in West Cork. I have 12 hectares of forestry on the poorer ground and 32 adjusted hectares of grassland. My farm is 2/3 dry ground and 1/3 heavy ground. Grassland management has become a key driver to the business over the past few years. Emphasis has been placed on prolonging the grazing season, reducing feed costs and increasing animal performance as a means of increasing output and profitability.

Paddocks are closed on the 10th of October on rotation and all animals are in by the 1st of December, if weather permits. I calf to grass, cows and heifers start calving around the 1st of February and go straight out if the weather is ok but will come in again if they are doing a lot of damage. All cows are calved by the 1st of April, you now have a bunch of calves only 8 weeks apart. I have only one group of animals on my farm, cows and bulling heifers are run together to make it easier for AI.

I won Beef Grassland Farmer of the Year in 2017, growing an average 14 tonne per hectare in the previous year. My farm is good to grow grass when all the conditions are right. However the grass growing year of 2012 and spring of 2013 were awful, and now the fall of 2017 and spring of 2018 were even worse. However the farm was growing around 7 tonne per hectare in 2012. In 2016, I was growing an average of 14 tonne per hectare. It was like having an extra farm next to me and my stocking rate went from 1.4 to 2.4 LU/ha.

Detailed description

<u>Innovation: Grass-Measuring using the Grasshopper and PastureBase Ireland</u>

All my soil samples were low for P and K at the start of 2012, now they are at index 3 for P and K and lime is around 6.7. I also soil sample every 3 years. I reseed around 10-15% of my farm every year. I walk the farm and measure my grass every week using the Grasshopper and upload it to PastureBase Ireland. The Grasshopper is an electronic platemeter that calculates kgDM/ha using a GPS system. On PastureBase you can see the paddocks that are doing well and the ones that are preforming poorly. Last year my paddocks ranged from 8-18 tonne per hectare. At €105 per tonne for every additional tonne of grass utilised, this means that the 8 tonne paddock is producing €840 of grass per hectare and the 18 tonne is producing €1890 per hectare. That's a difference of €1050. The paddocks that are growing only 8 tonne per hectare are ok in Lime, P and K but it is cold peaty ground. I also cut a lot of round bales of silage to keep grass in good condition. If a paddock is getting strong I will take it out if I have plenty of grass. This is where the PastureBase package comes in. It will tell you how much grass you have on the farm at all times. I cut around 5 bales per acre, most people think this is crazy but I feed the bales to the finishing bulls as they are around 75 DMD +. These bales save me around 1 tonne of ration per bull. Before I used the bales, I fed the bulls 2.5 tonne of ration. Now I feed 1.5 tonne /hd at €250 a tonne for ration which is worth €7500 for 30 bulls. I make between 200 and 400 bales every year keeping grazing paddocks in good condition.

My farm has 32 paddocks, roughly 1 hectare each. The more paddocks you have the more control you have over grass. I also have roadways running to most paddocks and every year I am putting in more roadways. It is easy to grow grass but to graze to 4cm is the hard part. It was a tough year this spring to do that. I have lots of ways to do this but they all take time. The way I look at it is, it costs me around €1200 a week to keep my cattle inside. If I can get them out earlier and keep them out longer it will pay off. If I got €1200 a week to put up wires and move stock in and out in bad weather it is a difference between making money and losing it. In very bad weather cows and bulling heifers will be left out for 3 hours a day to save silage. I will put cattle out full time and block graze every 12 hours if
they are not doing too much damage.

The suckler cows are separated from the calves 10 days before AI starts to get them cycling. The cows come in from the paddocks in the morning and evening to the calves. What I have found in bad weather is by letting the paddock wire open to the roadway, the cows are then waiting on the roadway to come into the calves. This way there is a lot less damage done to the paddock. When my cows and calves are grazing together all the wires in the paddocks are raised so the calves graze ahead of the cows. I have no creep feeder, my calves' average 1.3kgs a day weight gain for the heifers and 1.5kgs for the males. Every 0.1kgs weight gain is worth €100 to me. When you are finishing bulls you should try and get them as heavy as you can before weaning them. Bulls at grass are costing 30cent per day, inside to be finished cost €3, that's a huge saving.

I reseed around 10-15% of the farm every year, usually at the start of August, depending on how much grass I have. I pick the worst preforming paddocks and will drain it if it's wet. I have a low cost method for reseeding. I will burn off the paddock, if it has lots of grass I will cut it and bale it after 5 days or else get cattle in to graze it tight. After 2 weeks I will use a spring harrow and give the paddock 2 runs to make a fine seed bed. The paddock will get Lime at 2 tonne per acre and 2 bags of 10-10-20. I will set the seed with a Vicon fertiliser spreader at 14kgs per acre. At the moment I am using Abergain (*T*), Aberchoice (*D*) and Drumbo (*D*). I will use up to 60% Tetraploid in dry ground and 40% in heavy ground and then the field is rolled. I will spray the paddock with an undersown spray to kill the seedling weeds. It will get 27 units of N/acre and I will graze it mid-September with weanlings and might get another grazing if the weather is ok. All this costs around €100 per acre, I think it pays off for itself in one year. Normally you get 2- 4 tonne/ha boost from reseeding which is worth around €105 per tonne utilised. For 2018 I will incorporate clover into some of my paddocks.
For me, the more grass I grow the more profit I make!

Adoption criteria

I walk the farm and measure my grass every week using the Grasshopper and upload it to PastureBase Ireland. The Grasshopper is an electronic platemeter that calculates kgDM/ha using a GPS system. On

PastureBase you can see the paddocks that are doing well and the ones that are preforming poorly. Last year my paddocks ranged from 8-18 tonne per hectare. I also cut a lot of round bales of silage to keep grass in good condition. If a paddock is getting strong I will take it out if I have plenty of grass. This is where the PastureBase package comes in. It will tell you how much grass you have on the farm at all times.

Future prospects

My farm is good to grow grass when all the conditions are right. However the grass growing year of 2012 and spring of 2013 were awful, and now the fall of 2017 and spring of 2018 were even worse. However the farm was growing around 7 tonne per hectare in 2012. In 2016, I was growing an average of 14 tonne per hectare. It was like having an extra farm next to me and my stocking rate went from 1.4 to 2.4 LU/ha. I hope to continue this positive curve.

The Heffernan Family (Billy, Liam, and Mark)- Using Monocultures to Maximise Grass Output per Hectare

Farm: **The Heffernans**
Location: **Co. Kilkenny**

Background

Farm: 200 Ha – 3 blocks

Home: 132 (95 Ha owned, 37 Ha leased)

Outside block 1: 23.5 Ha – all leased

Outside block 2: 37.5 Ha – all leased

The home block is the milking ground.

The outside blocks are used for grazing the replacements and for silage production.

Milk is supplied to Glanbia.

Background

Billy started farming in Caherleske in 1983 having previously qualified as an FAB farm manager and spent 8 years milking 180 cows on a dairy farm in North Kilkenny.

For many years the home block of 45 Ha was farmed as a mixed farm with typically 40 dairy cows, 300/400 breeding ewes, a cattle enterprise and tillage – a mixed farm.

Now the farm is a Dairy Operation and is farmed in a family partnership.

Liam spent a year in Kildalton College, Piltown following which he studied at Clonakilty Agricultural College where he completed a Diploma in Dairy Herd Management. Liam returned home to farm full-time in 2004.

Mark has a degree in Construction Management and Engineering. Mark has also completed an Advanced Cert in Agriculture. Mark returned home to farm full-time in Spring 2011.

Farm History: Dairying

The farm has evolved overtime and has grown in cow numbers over the last decade to become a dairy farm. This is outlined in the table below.

Detailed description

Growth in cow numbers has being matched with both an increase in land base but also more grass grown on the farm. There has been a 50 % increase in grass production on this farm.

Grass Management

The farm was a monitor farm under the Glanbia joint programme for 3 years from 2008 to 2010. We began measuring grass in 2008 and have continued to do so ever since.

We walk the farm weekly and twice a week in times of high growth. Last year the farm was walked and grass cover was measured 50 times. This information is then entered into the PastureBase Ireland web-based programme. Pre-grazing covers and cover per cow are 2 key figures we use when making decisions.

The weekly farm cover measurements are also marked onto a farm map which is printed on a white board and located on the wall in the Dairy. This is an essential piece of equipment as all members of the family can clearly view the grass supply on the farm every week and the next paddocks to be grazed.

Reseeding Monocultures:

As grass is our main feed during the main grazing season, and the primary source of winter forage in the form of grass silage, the low level of reseeding must be addressed. Reseeding must be combined with managing, and where necessary increasing, soil fertility. Ireland will continue to increase milk production and the focus on efficient production of this milk is critical to maintain our industry competitiveness. Teagasc have developed a national grassland database (PastureBaseIreland), and the initial results show that there is huge capacity on Irish farms to grow more grass. The objective of this handbook is to outline the key points in grassland reseeding and to ensure farmers making the investment in renovating grassland get the best possible result.

Why reseed?

Productive grassland farms must have perennial ryegrass dominated swards. Recent Moorepark research shows that old permanent pasture produces, on average, 3 t DM/ha per year less than perennial ryegrass dominated swards. Old permanent pasture is up to 25% less responsive to available nutrients such as nitrogen than a perennial ryegrass dominated sward. Reseeding is a highly cost effective investment. With regular reseeding the grass growth capacity of the farm can be increased substantially and the annual return of investment is large.

Variety choice

The DAFM publish the recommended list, showing the Pasture Profit Index values and agronomic values of the evaluation on the same table (see https://www.teagasc.ie/crops/grassland/pasture-profit-index/).

The Recommended List has evaluated varieties across years and sites and is the only evidence available of the potential performance of grass cultivars in Ireland. Using varieties not on this list is basically poor decision making, as is buying grass seed on price. The varieties you use on the farm, will be there for 8-12 years, choosing to use cheap mixes, with non-recommended varieties will increase the chances of those varieties failing to perform on the farm.

When the decision to reseed is made, the next major decision is selecting the most appropriate grass variety or varieties. The first thing to consider is the primary target use of the field. Is it predominantly grazing or is it generally used as a silage paddock? How much tetraploid should be used? A balance between quality, dry matter productivity and sward density is generally what must be achieved.

The key traits in a seasonal grass based production system are:

- High quality
- High seasonal production
- Good persistency score

Differences between diploid and tetraploid varieties

Tetraploid varieties

- Tall upright growth habit
- Prostrate growth habit
- Create more ‘open’ sward

Diploid varieties

- Create a denser sward with less “open” spaces
- Higher digestibility value
- Generally lower digestibility and yield

Combining diploids and tetraploids in a mixture will create a dense, high quality sward – ensure you select varieties which express high performance in the key traits. Increasing the proportion of diploids on heavier soils is recommended to create better ground cover, however tetraploids should be used on heavy soils. Choosing all dense varieties will compromise DM production and grazing utilisation.

Key points when choosing a variety:

- Decide what the end use is – grazing or silage – formulate based on this

- Focus on the key traits increase the proportion of the varieties with the key traits
- Sow 35 kg/ha (14 kg/ac) of seed
- Less than 7 days range in heading date between varieties
- Grazing specific mixtures
- Varieties exhibiting high seasonal (Spring and Autumn) PPI values
- Varieties with high quality sub index values
- Silage specific mixtures, e.g. 2-cut system
- Varieties which have high silage sub index values
- Ensure proximity of heading dates
- Avoid low silage sub index diploids and poorly persistent tetraploids

Results

Measuring Grass:

1. Minimise costs to cope with volatile world markets
2. Maximise the proportion of grazed grass in the diet
3. Maximise pasture re-growth rates
4. Improve pasture quality, feed more grass, and at a higher quality
5. Graze more grass in the spring and autumn, shorten the winter period
6. Achieve target average farm covers at key times during the year

Method: Eyeballing

Quadrat and shears.

Once you become confident at estimating the quantity of grass in the paddock you can start to estimate it by eye (eyeball) it.

- A 0.5m x 0.5m quadrat is placed in an area that is representative of the amount of grass in the paddock.
- Knock water off the grass before cutting if wet.
- The grass within the quadrat is cut to between 3.5 and 4cm.

- The following equation is used to calculate the DM yield in the paddock:
- Weight of grass (kg) x grass DM% x 40,000 = kg DM/ha in the paddock

Example: Grass cut within the quadrat weighs 200g (0.200 kg)

(Remember to subtract the weight of the empty bag) Grass DM% = 16% (0.16) 0.200 kg x 0.16 x 40,000 (there are 40,000 quadrats in a hectare) = 1,280 kg DM/ha.

Adoption criteria

Discussion Groups

We are active members of our local discussion groups, the Castlehale Discussion Group. Billy was a founding member of the group over 30 years ago. We have benefitted enormously from interaction with other group members and by learning/taking new ideas when visiting other members' farms.

We are also members of the 'Grass 2 € 'grass group. This group is made up of members of our local group together with members of other neighbouring groups. Also while the farm was a monitor farm it was used as a host farm to run 2 grass courses (each attended by 15-20 farmers) over a number of months in each of 2009 and 2010.

We would like to thank our Teagasc advisor Michael Freaney for all his support to us over the years as well as running the local discussion group. We are delighted to have been awarded this prize and would like to thank everyone who has been part of organising the walk today.

Future prospects

Increase grass production per hectare in the future. Achieve more grazing rotations per paddock per year and increase the profitability of the system going forward.

Grazing Monocultures with Mixtures

Farm: **John McNamara**
Location: **Hospital, Co. Limerick**

Background

Name: John McNamara

Enterprise: Dairy Farmer

From: Hospital, Co. Limerick

Farm Size: 116Ha (78Ha Milking Platform)

2017

Annual Tonnage: Avg 16T Grass DM/Ha

Grazings: 8.5 Grazings/Paddock/Year

Stocking Rate: 3 LU/Ha (Milking Platform). 2.7LU/Ha (Whole Farm)

KgMS/Ha: 912 KgMS/Ha (Whole Farm)

John is the 2018 Overall & Dairy Grassland Farmer of the Year. John farms with his wife Olivia just outside Hospital, Co. Limerick. They grew an average of 16T Grass DM/Ha whilst achieving an average of 8.5 grazings per paddock on their farm in 2017. Whilst they excel in all areas of grassland management they put particular focus on building their grazing infrastructure and reseeding lower performing paddocks.

Detailed description

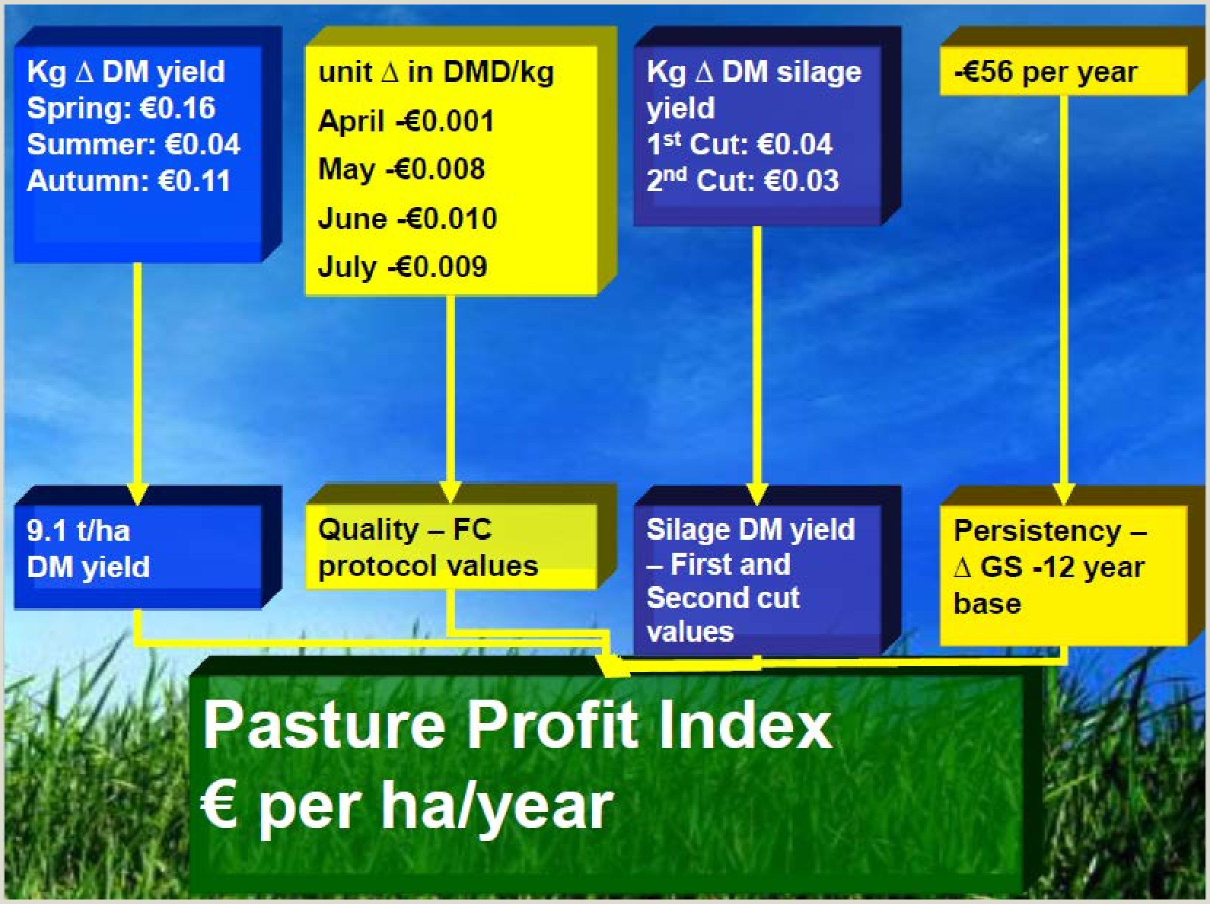
Pasture Profit Index - Overview

Total merit index developed to assist in cultivar selection

- Assigns an economic value to important traits of grass performance
- Define the total economic merit of a cultivar (€ per ha per year)
- Rank cultivars on Total Economic Merit

Traits of importance:

- Seasonal DM yield
- Quality
- Silage DM Yield
- Persistency



Focus on important traits for an Irish grass based production system.

When the decision to reseed is made, the next major decision is selecting the most appropriate grass cultivar or cultivars. The first thing to consider is the primary target use of the field. Is it predominantly grazing or is it generally used as a silage paddock?

How much tetraploid should be used? A balance between quality, dry matter productivity and sward density is generally what must be achieved.

Tetraploid cultivars	Diploid cultivars
Tall upright growth habit	Prostrate growth habit
Create more ‘open’ sward	Create a denser sward with less “open” spaces
Higher digestibility value	Generally lower digestibility and yield

Combining diploids and tetraploids in a mixture will create a dense, high quality sward – ensure you select cultivars which express high performance in the key traits. Increasing the proportion of diploids on heavier soils is recommended to create better ground cover.

Adoption criteria

- Discussion group and advice
- A grass based system
- A robust system to cope with low milk price years
- Soil fertility
- Reseeding programme
- Grassland measurement

Future prospects

John uses monocultures and mixtures from varieties from the Pasture Profit Index to ensure that:

- Maximum grass output per ha is achieved on the farm
- Grass quality is excellent so paddocks can be grazed down to 4 cm throughout the grazing season
- Maximum milk solids per cow can be achieved on the farm from grass and 600 kg concentrates per year

Michael Doran- Converting from Beef to Dairy Farm

Farm: **Michael Doran**
Location: **Johnstown, Duncormick, Co. Wexford**

Background

Michael Doran is quite a new entrant to dairy farming based at Johnstown, Duncormick, Co Wexford, just one mile as the crow flies from the sea. Michael had 135 cows when he joined the Teagasc Glanbia Monitor Farm Programme, he is now milking 240 cows.

When Michael's father was growing up, his parents had a mixed farm with 12 cows all milked by hand, some sheep and tillage. They stopped milking cows in the 1950's. Michael studied agricultural at Rockwell College finishing in 1994 and came home to farm full time. His father transferred over the running of the farm over a period of five or six years.

Michael's heart was in the beef sector. He won Beef Student of the Year in Rockwell and his wife, Ciara, was a Beef Advisor with Teagasc.

Michael started with 50 suckler cows, 75 ewes and 12 hectares of cereals. He became a well known suckler farmer, working progressively to increase the suckler herd to 120 and sheep to 200, with 40 hectares of grain.

Michael researched further looking at the profits being made by good quality dairy farmers and felt it would be a logical decision at the time to switch from beef to dairy, as he believed it would offer better opportunity and profitability for his family, especially as milk quotas were being abolished.

'I had never milked a cow. But this was the best decision we ever made for the farm,' says Michael. 'From the profitability and financial point of view but also in terms of our lifestyle as a family.'

He and Ciara had a lot of contacts in Teagasc and spoke with advisors and researchers at Moorepark who gave them very valuable advice. In 2013 he applied for a milk quota under a new scheme for entrants and was originally allocated a quota of 200,000 litres.

Michael set about building a new 24-unit herringbone milking parlour, upgrading roadways on the farm and sold about 60 suckler cows to buy 80 in-calf Jersey cross heifers.

Michael put a lot of thought into the type of cow to have in his new herd. His decision to go with Jersey cross cows was supported by advice and research and was based on the their good track record in fertility, the solids these animals produce and that they can be easy to manage, which was a factor also in his first year in dairy farming. He also wanted to buy in from as few places as possible and managed to buy the first 80 in calf heifers from two farmers in October 2013. He milked his first cow in January 2014 and started supplying manufacturing milk to Glanbia Ireland.

Detailed description

Glanbia/Teagasc MONITOR FARM PROGRAMME

Michael was asked to join the Teagasc Glanbia Monitor Farm Programme in 2015 and says it was a ‘brilliant’ decision. The joint programme set out to help dairy farmers promote sustainable growth post-quotas. Michael has found the experience very useful as he has had access to superb information and more people looking at what he is doing, feeding in to new ideas for the farm.

‘It’s been fantastic. We’ve seen big improvements in a number of areas but the focus on finance and planning has been especially useful.’

Michael had 135 cows when he joined the Teagasc Glanbia Monitor Farm Programme but recognised that when he reached a herd size of 200 cows he would also be reaching the limit of what the farm could carry without having more land. In 2015 Michael purchased an adjoining 26 hectare block. He sold about 16 hectares of land five miles away from the milking platform and while the sale of the original land did not cover the full cost, the additional land increased the milking platform to 80 hectares.

MANAGING THE COSTS OF EXPANSION

Michael continued to expand his herd by purchasing animals from as few herds a possible to minimise the risk of disease transmission. This year (2018) he is milking 240 cows.

Over the a three year period from 2013, Michael invested €309,500 on infrastructure alone including the new parlour/dairy, housing cubicles, storage and also work to bring the land bought from tillage into grass – this meant field infrastructure such as water, roadways and fencing.

‘The Monitor Farm Programme has given me a brilliant discipline about financial planning,’ says Michael. ‘Managing our finances has been crucial with this type of investment. We use the Cost Control Planner every year and have six year plans in place for the farm which are reviewed regularly. It has helped us to stay on top of our finances.’

Michael has managed to reduce variable and fixed costs between 2014 and 2017. The overall net profit per cow has increased from 607 €uro per cow in 2014 to 936 €uro per cow in 2017.

Results

MAKING THE GRASS SYSTEM WORK PROFITABLY

Michael is a firm believer that having the right cow and getting grassland management right are two critical components of working the grass based system – ‘and converting money to my bank account.’

'I called myself a grass farmer before I called myself a beef or dairy farmer,' says Michael. He has been measuring grass since 2008. Since getting involved with the Monitor Farm programme he has made further improvements in grazing the correct heights of grass and setting up the right paddock sizes.

Michael's average milk yield in 2017 was 4,754 litres but he says that pushing big yields is not as important as improving solids and maximising production from grass. Average milk solids in 2017 were at 427 Kg, protein % at 3.87 and fat % at 4.85, with 55% of the herd first and second calvers.

In 2017 stocking rate was 2.85 (Lu/Ha). Michael was achieving 18 Kg DM/hectare grass growth but had also improved soil fertility with Ph >6.3 at 85% in 2017 up from 20% in 2015. P Index 3/4 was up to 90% in 2017 from 65% in 2015; and K index 3/4 was at 95% in 2017 from 90% in 2015. He is doing soil testing every year to 'keep a handle on it all.'

MANAGING A LARGE HERD

Michael appreciates he has learned a lot about managing a large herd through the Monitor Farm Programme but also describes his vet as a key member of his team. 'We look at herd reports and plan together to make sure we have a good vaccination programme in place and that we are managing health as well as we can – preventing infection and minimising risks of any illness properly.

This year he tried Contract Rearing for the first time with 40 animals. 'It did free up more time and made sure our stocking rates weren't under pressure, especially when we faced conditions like drought.'

Adoption criteria

- Lots of planning
- A grass based system
- A robust system to cope with low milk price years
- Soil fertility
- Reseeding programme
- Grassland measurement

Future prospects

WORK & LIFESTYLE BALANCE

'Dairy farming needs a big commitment but I find I can manage it more efficiently than my previous beef enterprise.' says Michael. Previously he had about 13 groups of animals grazing and there was always something to do with so many groups of animals. Now he does his first milking at 7am and finishes the evening milking at about 5pm.

Michael now has two labour units working with him on the farm. Spring is always a busy time so the first five months they work every second weekend. When breeding is over this moves to everyone working every 3rd weekend so that he has more time with his family. He also manages to take a summer holiday in July each year, which would have been impossible on his previous beef enterprise.

Michael and Ciara have three children now – Ella aged ten, James aged six and Tomós is five. Both boys started primary school in September 2018, which is a big step. Michael hopes that one of them may be interested in the farm in the future but is determined that the farm that he passes on will be as good if not better than the farm he got from his parents. ‘That’s what family farming is really all about,’ says Michael.

Peader Kearney- Implementing Grazing Infrastructure to Grow More Grass on a Sheep Farm

Farm: **Peader Kearney**
Location: **Ardee, Co. Louth, Ireland**

Background

The farm comprises of 27 Ha of which 16 Ha is located on an out farm and 10 Ha on the home block. Peadar operates a sheep only enterprise of 300 ewes producing lambs for the factory and replacement ewe lambs for sale. Replacements are kept on the farm. However ewe lambs are not mated. The running of the farm is greatly assisted by local farmer and Ag. Graduate Joanne Martin who has a keen interest in the breeding and performance recording taking place on the farm.

Detailed description

Grazing Infrastructure on Peadar's Farm

Originally when Peadar started farming this block of land where we stand today there was 7 large fields. From this point the paddocks were mostly divided in two resulting in 14 paddocks being created. This comprised of a combination of permanent and temporary fencing. Water pipes were laid with moveable drinkers. This increased grass utilisation on farm. However paddock sizes were still difficult to operate a rotational grazing system.

Following on peadar strategically placed temporary fencing to crease a total of 24 paddocks on the farm approx 1.6 acres per paddock. Even though 3 reels of temperoary fencing are used they remain in place during the main grazing season on a permanent bases. This reduces the labour involved in moving them on a regular basis.

Strip Grazing

1. Set up a grazing block to feed your livestock for a maximum of 3 days.
2. Put up a back-fence when moving livestock on to the next block.
3. Sheep get fresh grass while regrowth occurs on grazed block.
4. Sheep should graze down to (3.5-4cm ewes) (5.5-6cm lambs post weaning) before moving them on.
5. Sheep should be entering grass covers of 8cm grass.

Adoption criteria

- Discussion group member
- Registered on PastureBase Ireland
- Walks the farm once per week
- Contacts his advisor when guidance is required to make good decisions

Peadar has had a keen focus on grassland management over the past number of years. He started measuring grass in 2010 with his local Teagasc advisor Hugh Rooney. The farm is walked on a weekly basis and the measurements are inputted into PastureBase Ireland. This has been a huge aid to manage grass on the farm. Last year the farm produced over 12t DM/Ha last year.

Future prospects

- Increase the amount of quality grass in the lambs diet
- Less workload feeding silage, meal etc.
- Overall make more profit through quality grass!

There have been significant improvements made in previous years increasing the number of paddocks on the farm to increase grass utilisation. Peadar is also a member of the BETTER farm sheep programme since 2014 which has improved the efficiency and output from the flock with the help of BETTER farm sheep advisor Frank Campion. Peadar also actively participates in the local Knowledge Transfer discussion group facilitated by local Teagasc advisor Hugh Rooney.

Robert O'Dea- Measuring Grass Using PastureBase Ireland to Make Better Grazing Decisions and to Increase Grassland Performance

Farm: Robert O'Dea
Location: **Co. Limerick Ireland**

Background

YouTube Video:

https://www.youtube.com/watch?v=Ak0Nc5qfUXo

https://www.youtube.com/watch?v=e4KC8ssJSBE

Robert O'Dea is walking his farm every week and grass budgeting to maximise the proportion of grass in the cows diet and to extend the number of days at grass on his farm.

Measuring grass helps Robert to:

1. Take the guesswork out of managing grass
2. Identify grass surpluses and deficits quickly
3. Know when to reduce, or cut out, meal feeding in spring

4. When in deficit, calculate extra meal or silage needed to feed the herd
5. Follow a spring rotation planner to deliver high quality swards for summer grazing
6. Know when to start the 2nd rotation in spring
7. Know when to end the last grazing rotation in autumn
8. Build up extra grass cover in late summer for grazing in autumn
9. Know when and how to react to a constantly changing grass supply on the farm
10. Decide on the grazing plan for the week and keep all staff informed on decisions

Detailed description

Robert is part of a number of discussion groups where he can benchmark his grassland performance against other members of the group. Robert likes using PastureBase Ireland as it is a data-base where he can analyse his farms grassland performance.

PastureBase allows Robert to:

1. Benchmark your performance against farmers in your discussion group
2. Build a comprehensive grass database for your farm to help you in years to come
3. Calculate the tonnes of grass grown by each paddock each year
4. Identify paddocks with low annual tonnage and earmark them for reseeding

Maintaining a constant supply of high quality green leafy grass can be easily achieved by walking paddocks weekly and measuring the amount of grass on the farm. Poor grazing management leads to fluctuation in pre-grazing yields, with problems of not enough or too much grass on the farm.

Robert began measuring grass using the cut and weigh method. He has since then developed his eye to be able to identify grass covers in paddocks (eye-balling).

Cut and Weigh Method:

- A 0.5m x 0.5m quadrat is placed in an area that is representative of the amount of grass in the paddock.
- The grass within the quadrat is cut to between 3.5 and 4cm.
- The following equation is used to calculate the DM yield in the paddock:
  Weight of grass (kg) x grass DM% x 40,000 = kg DM/ha in the paddock
- Example: Grass cut within the quadrat weighs 200g (0.200 kg)
  (Remember to subtract the weight of the empty bag) Grass DM% = 16% (0.16) 0.200 kg x 0.16 x 40,000 (there are 40,000 quadrats in a hectare) = 1,280 kg DM/ha.

Adoption criteria

- Discussion group member
- Registered on PastureBase Ireland
- Walks the farm once per week
- Contacts his advisor when guidance is required to make good decisions

Future prospects

Grassland measurement has allowed Robert to:

- Increase milk output per cow and per hectare
- Reduce variable costs such as concentrates and silage on his farm
- Carry more livestock as grass growth increases on the farm
- Increase the amount of quality grass in the cows diet
- Less workload feeding silage, meal etc.
- Overall, Robert is making more profit through quality grass!

Setting up a New Dairy Farm on a Greenfield Site

Farm: **Greenfield Farm**
Location: **Co. Kilkenny, Ireland**

Background

The original farm business plan for the Greenfield Dairy Farm can be accessed at (http://www.greenfielddairy.ie/node/103). The plan was based on minimising capital investment on the farm while expanding cow numbers in order to maximise grass utilisation (Table 1). Cow numbers were projected to increase from 250 in Year 1 (2010) to 350 in Year 10 (2019). Milk solids yield per hectare was projected to increase from 760/ha in Year 1 (2010) to 1300kg/ha in Year 10 (2019). Cow numbers (including in calf heifers) on the farm on the first of January were 250 in Year 1 (2010), 307 in Year 2 (2011) 306 in Year 3 (2012), 346 in Year 4 (2013), 332 in Year 5 (2014) and 334 in Year 6 (2015). Milk solids/hectare was 737 kg/ha in Year 1 (2010) and 962 kg/ ha in Year 2 (2011), 983 kg/ha in Year 3 (2012), 1,090 kg/ha in Year 4 (2013), 1,079 kg/ha in Year 5 (2014) and 1,089 kg/ha in Year 6 (2015). Grass growth has increased from 12 t DM/ha in 2010 to 13.9 t DM/Ha in 2015. However, the farm is prone to drought, which was observed on the farm in 2013 with grass dry matter production running at just over 10 t/ha resulting in a significant deficit in feed supply and adding substantial cost to the overall business (feed costs in 2013 circa €103,000 versus 2014 circa €20,000).

The Greenfield Dairy Programme was created in partnership with key industry stakeholders including the Department of Agriculture, Fisheries and Food, Glanbia plc, FBD Trust, Irish Farmers Journal and AIB.

Detailed description

Grazing management

The key success driver of the Greenfield Dairy Farm is the amount and quality of grass the farm can produce. Each year since 2012 the farm has increased the amount of grass grown per hectare, with the exception of 2013. The Greenfield Dairy Farm has increased its stocking rate since the farm was set up. In 2014, an additional 8 ha was leased next to the parlour. In 2016, the average stocking rate will be around 2.80 cows/ha. Winter feed production has been variable since the start of the project.

The overall requirement of winter feed is increasing each year due to the increasing stocking rate. In 2015, 273 cows were wintered and all the culls were sold the previous autumn. By early December all the cows are dry and housed on the stand-off pad full time. The cows go to grass immediately post-calving. For the past two years the last of the cows to calves (30-40) have gone to the contract rearer for 4-6 weeks in early January; this helps to reduce pressure on winter feed and the plan is for this to continue. In

2012, 2014 and 2015 the farm was able to grow enough winter feed. In 2013, winter feed was bought in due to the poor grass growth that year. In the spring about 100-120 kg meal is fed per cow. Grass supply is generally tight towards the end of March so high quality bales are kept for the milking cows to increase rotation length. Similarly, in August when building up grass cover, cows usually get high quality bales to increase rotation length for 10 days. For the past two years the area cut for second cut silage has been reduced; when there is surplus grass; it's cut as high quality bale

silage. Winter growth is averaging 2.2kgs per day over the past 4 winters.

In terms of day to day grazing practices, cows graze pre-grazing covers of 1,500 kg DM/ha during the main grass growing season in 24 to 36 hour allocations. The post grazing height in the main grass growing season is about 4cm. The farm has never been topped and instead, paddocks are removed as bale silage when the pre-grazing paddock cover exceeds 1,600 kg DM/ha. Each year, approximately 25% of the grazing area is stopped for a large first cut of grass silage.

The Teagasc Greenfield Dairy Programme aims to provide family farmers with the skills and technologies to expand milk production and profitable grow their businesses into the future. At farm level, this will necessitate the adoption of key technologies including high quality pasture management, compact calving, higher stocking rates, high EBI replacement heifer rearing, larger herd management and low cost labour efficient farm infrastructures. At farm level this will only be a success if it is complemented with a detailed 5-year business plan.

The farm is soil sampled annually and the farm is in nitrate derogation since 2012. The farm has been allowed spread 30,000 kg N/year and we believe this is definitely reducing grass production especially on a farm that is low in soil organic matter and newly reseeded. Initially, N fertilizer was bulk spread monthly, however this has been changed to weekly spreading since 2013. Since 2013, the farm is getting two rounds of sulphur (33 kg/ha). Potash is mostly applied to grazing ground from July onwards with a small amount applied in the spring; this as a precaution against grass tetany.

Lime has been applied since 2014. The pH of the soil has decreased by -0.33 from 2012 to 2016. In 2014, the farm got 100 tonnes of lime and 200 tonnes in 2015. The 2016, soil fertility test indicates that the farm needs another 300 tonnes of lime. The plan was to spread it in the Spring of 2016; but it was too wet. The paddocks that have a lower pH on the farm also have a lower P level also. Soil testing annually gives a good indication of soil fertility on an intensive farm.

Adoption criteria

In 2013 and 2014, additional land (8ha) was leased and was reseeded with two more monoculture grasses (Kintyre, Aston Lord and Aberwolfe). Clover has been set in all paddocks and is growing actively from May onwards. Some cultivars are growing more grass and are very palatable. Others are growing high yields of grass but are not as palatable for the cows. Each year some perform better than other cultivars. This is probably to do with the fertility of the paddock. The paddocks that grow the most grass and the silage paddocks (incl. surplus bales) tend to drop in fertility very fast.

Future prospects

John uses monocultures and mixtures from varieties from the Pasture Profit Index to ensure that:

- Maximum grass output per ha is achieved on the farm
- Grass quality is excellent so paddocks can be grazed down to 4 cm throughout the grazing season
- Maximum milk solids per cow can be achieved on the farm from grass and 600 kg concentrates per year

Tim Crowley: Grassland Innovation: Grazing Monocultures to Increase Grass Production and Utilisation

Farm: Tim Crowley
Location: **Bandon, Co. Cork, Ireland**

Background

Video: https://www.youtube.com/watch?v=pRs-rCBE8sI

Farm Performance

Timmy and his father Dan Crowley are farming 82ha of land of which 33ha is leased. Since quotas were abolished in 2015 herd size has increased from 90 cows to 150 cows today with a plan to milk 180 cows in 2019. The purchase of 15ha of land on the milking block in 2017 allowed Timmy to increase his milking platform to 59ha. Currently there is a stocking rate of 2.52cows/ha on the milking block and next year Timmy will push this to a stocking rate of 3cows/ha based on his production of grass.

This focus of output and profit on this farm is stemmed from high grass utilization. Timmy fed 680kgs meal/cow in 2017 and the rest of the herds' diet was made up of grazed grass and grass silage. Timmy sold 422kgs milk solids/cow to the co-op in 2017 or 1122kkgs/ha. The target is to sell 1350kgs/ha of milk solids from a predominately grazed grass diet. With a strong focus on high grass utilization on this farm, Timmy's total costs for 2017 were 16.6c/litre with a Dairy Output of 39.1c/litre.

As with high grass utilization good herd genetics has also a role to play in the high performance of this farm. The herd EBI of this black and white herd is €113. Calving interval was 367days in 2017 and the six week calving rate has hovered around 80% the last five years. Compact calving is key to profitability where Timmy can get high numbers of cows to grass early in the spring, which increases the value of milk sales and reduces feed costs. Getting high volumes of cows out to grass in February is first key step to achieving ten rotations.

Detailed description

Investing in Grazing:

In order for expansion to be successful, there will be a requirement for significant investment on many farms. The available capital for this investment will be a scarce as expansion happens and continues. Therefore, investment on farm should be prioritised at areas that increase efficiency and reduce the exposure of the business to external shocks such as lower price of product or higher price of inputs etc. All investments that give the highest returns should be prioritised.

Every ton of additional grass eaten by the grazing animal will add €180/ha additional profit to a dairy farm. Therefore it is important that investment in grazing is prioritised to give the maximum return. The table below summarises the potential return on investment for different investments in a dairy farm business. Bottom Line: The level of return to these investments is high because it is investing in grazing. These investments will either enable the farm to grow more grass or lengthen the grazing season or both.

The need for more reseeding:

As grass is our main feed during the main grazing season, and the primary source of winter forage in the form of grass silage, the low level of reseeding must be addressed. Reseeding must be combined with managing, and where necessary increasing, soil fertility. Ireland will continue to increase milk production and the focus on efficient production of this milk is critical to maintain our industry competitiveness. Teagasc have developed a national grassland database (PastureBaseIreland), and the initial results show that there is huge capacity on Irish farms to grow more grass. The objective of this handbook is to outline the key points in grassland reseeding and to ensure farmers making the investment in renovating grassland get the best possible result.

Why reseed?

Productive grassland farms must have perennial ryegrass dominated swards. Recent Moorepark research shows that old permanent pasture produces, on average, 3 t DM/ha per year less than perennial ryegrass dominated swards. Old permanent pasture is up to 25% less responsive to available nutrients such as nitrogen than a perennial ryegrass dominated sward. Reseeding is a highly cost effective investment. With regular reseeding the grass growth capacity of the farm can be increased substantially and the annual return of investment is large.

Adoption criteria

Variety choice

The DAFM publish the recommended list, showing the Pasture Profit Index values and agronomic values of the evaluation on the same table (see https://www.teagasc.ie/crops/grassland/pasture-profit-index/).

The Recommended List has evaluated varieties across years and sites and is the only evidence available of the potential performance of grass cultivars in Ireland. Using varieties not on this list is basically poor decision making, as is buying grass seed on price. The varieties you use on the farm, will be there for 8-12 years, choosing to use cheap mixes, with non-recommended varieties will increase the chances of those varieties failing to perform on the farm.

When the decision to reseed is made, the next major decision is selecting the most appropriate grass variety or varieties. The first thing to consider is the primary target use of the field. Is it predominantly grazing or is it generally used as a silage paddock? How much tetraploid should be used? A balance between quality, dry matter productivity and sward density is generally what must be achieved.

The key traits in a seasonal grass based production system are:

- High quality
- High seasonal production
- Good persistency score

Differences between diploid and tetraploid varieties

Tetraploid varieties

- Tall upright growth habit
- Prostrate growth habit
- Create more 'open' sward

Diploid varieties

- Create a denser sward with less "open" spaces
- Higher digestibility value
- Generally lower digestibility and yield

Combining diploids and tetraploids in a mixture will create a dense, high quality sward – ensure you select varieties which express high performance in the key traits. Increasing the proportion of diploids on heavier soils is recommended to create better ground cover, however tetraploids should be used on heavy soils. Choosing all dense varieties will compromise DM production and grazing utilisation.

Key points when choosing a variety:

- Decide what the end use is – grazing or silage – formulate based on this
- Focus on the key traits increase the proportion of the varieties with the key traits
- Sow 35 kg/ha (14 kg/ac) of seed
- Less than 7 days range in heading date between varieties
- Grazing specific mixtures
- Varieties exhibiting high seasonal (Spring and Autumn) PPI values
- Varieties with high quality sub index values
- Silage specific mixtures, e.g. 2-cut system
- Varieties which have high silage sub index values
- Ensure proximity of heading dates
- Avoid low silage sub index diploids and poorly persistent tetraploids

Future prospects

Productive grassland farms must have perennial ryegrass dominated swards. Recent Moorepark research shows that old permanent pasture produces, on average, 3 t DM/ha per year less than perennial ryegrass dominated swards. Old permanent pasture is up to 25% less responsive to available nutrients such as nitrogen than a perennial ryegrass dominated sward. Reseeding is a highly cost effective investment. With regular reseeding the grass growth capacity of the farm can be increased substantially and the annual return of investment is large.

Feeding meat breeds with meslin, an excellent way for autonomy and resilience

Farm of Catherine Faux
Location: **Strée (Beaumont), Belgium**

Background

Catherine's farm located near the municipality of Beaumont (Belgium), a rural area dedicated mainly to husbandry. Catherine's farm (in organic conversion for 2 years) is a mixed farm with meat breeds of ewes (Ile de France and Entre Sambre and Meuse) and cows (limousine) regularly grazing together on 42 hectares (1 FTE). Catherine took back the farm 8 years ago. The farmer's strategy focuses on farm autonomy, the short chain of marketing and is characterized by a great deal of curiosity in the field of grassland management and the technical aspects related to grassland management. Catherine develops the production of meslin (mixture of straw cereals and legumes).

Detailed description

For three years, Catherine has been experimenting with different practices in order to develop the fodder and protein autonomy of the farm, while limiting the inputs:

- Production of different types of meslin for mowing and harvesting:
    - Oat / triticale / peas => Feeding lambs from 1 month old (slaughter at 4 months, never completely weaned)
    - Spelt / oat / triticale / vetch => feed for ewes => diversity of feeds, positive impacts on animal health
- Dual purpose management of legumes and forage mix components (eg production of triticale and organic peas that can also be sold outdoors = adjustment variable)
- Grassland improvement by oversowing, for example through the use of Sencier blends
- Choice of breeds of animals (hardiness, ability to value different types of fodder)

- Improvement of the practice of rotational grazing: adjustment of the plot by block of 1 hectare (the cows remain 4-5 days on each block). Standard = 1 are per cow and per day and equipment of each block with a trough. Permanent grassland, are both grazed and mowed (4 times a year) The duration of permanent meadows is greater than 20 years.

Results

- The goal of autonomy is achieved (no purchase of food, except in 2018). All foods are homemade. Profitability is good despite the organic conversion period (no premium). Comparative trials were carried out to measure the economic interest of the meslin: the growth of lamb fed with meslin (14% protein, 160 € / ton) and with a commercial food (17-18% of protein, under -products, € 307 / ton) was compared. The quantities ingested and palatability are identical and the growth obtained equivalent.
- Grassland quality (species composition, nutritional value) is improved
- The quality of meat production (taste, nutritional value, etc.) marketed in particular through the Coprosain cooperative is appreciated
- Various elements are put forward by Catherine to justify the interest of producing meslin:
  - It does not require inputs, just manure
  - The amplitude of the dates for meslin implantation makes it possible to sow it even late
  - The meslin quickly covers the soil after implantation and grows rapidly in the spring, ensuring good weed competitiveness.
  - Complementarity of species within cereal / protein-crops mixes allows better resistance to diseases.
  - The adaptability and flexibility of the crop allows harvesting at different times depending on the objective pursued.
  - Early harvest will allow to plant a summer crop under better conditions (moisture and soil structure).
  - The meslin provides security to the fodder system because the implantation, harvesting and valuation modes are multiple. Harvested in late spring, it is generally not subject to water stress.
  - Meslin is usually a forage well balanced in nitrogen and energy.

- Rich in fibber, it promotes rumination. Harvested early and rich in legumes, it contributes to the protein's autonomy of the ration.
- The place of a meslin in the rotation is flexible
- After a meslin, one can plant a meadow, a straw cereal or a spring crop but also another catch crop or an intermediate crop (depending on the date of harvest of the meslin). The meslin also has the advantage of making available the plot early and without crop residues.
- Finally, in terms of biodiversity, the meslin offers a shelter and a cover diversity to the insects and birds: "it is the feast for bees and the swallows"
- No need to mix the food (chopped on the field)
- Storage of immature meslin in "sausage shape" plastic wrap can "save the day" in case of climatic problems.

Adoption criteria

- Beyond the aspects mentioned in point 3, the meslin is inexpensive to produce, but it is adapted to rustic animals (low needs), not for dairy cattle. The financial aspect can therefore be a factor favouring the adoption of the meslin.
- The tonnage harvested (1 ha of meslin gives 4-5 tons) can on the other hand constitute a psychological barrier for some farmers
- The cost of seeds is a constraint. Catherine and her husband are looking for solutions to produce their own seeds (difficult to sort because constituted of 5 different seeds, another constraint) => Next step in the process of autonomy: seed autonomy.

Future prospects

Various reflections/thinking still need to be made to improve the system:

- How to better manage climate hazards? Is overseeding a solution? To be investigated…
- Are the species used for meslin production optimal, adapted to local conditions? It is necessary to build a baseline on the subject
- The cost of seeds for meslin production is a drag. What steps to initiate, what solutions to implement to produce optimal seeds autonomously, adapted to local conditions?

- The construction of a knowledge base is important: calculating profitability, monitoring the growth curves of the animals fed with the meslin according to the types used, the type of cattle and its stage of development, etc..

Environmental services, grassland improvement and on-farm dairy processing

Jambjoule Farm
Location: **Villers-sur-Lesse (Rochefort), Belgium**

Background

Bernard Convié and his wife Valérie Calisis, run the family farm Jambjoule. This mixed organic livestock farm (sheep breeds and dairy cows) is located in Villers-sur-Lesse (Rochefort Municipality). The land and the farm belong to the royal domains.

Sheep farming (300 sheep of the Roux Ardennes and Mergelland breeds) is based on the valorisation of calcareous meadows (Nature Reserves) and grasslands with a high biological value, of which 86% are Natura 2000 areas, with a view to maintaining and developing the biodiversity. Thus, in addition to a production objective, the farm also provides environmental services for the benefit of the common general interest.

Dairy cows, Jersey breed, essentially exploit the meadows located around the farm (quick-rotational grazing on short grass) as well as the fodder produced on the farm.

In matter of grassland management, Bernard has been experimenting, for 3 years, different practices in order to develop the forage and protein autonomy of the farm.

Detailed description

Dairy cows have important requirements for forage quality. In Famenne (ruminant breeding area), arable land is scarce. With very few arable land, Bernard does not have the possibility of having temporary meadows and in this context, he seeks to improve the quality of his "obligate" meadows. To improve its grassland, it tests different forms of over-seeding of meadows: over-sowing using a pneumatic sowing machine (on-the-fly type) behind a dung spreading harrow or using an Aitchison seeding (equipment used in cultivation technique simplified in order to create seed beds in existing crop) that sows in furrows located every 15 centimetres at shallow depth.

Bernard also conducts trials at different times (either early in the season or after the first cut, using different mixtures on mowing plots). Bernard has also made small attempts at sowing grain in grassland (oats and peas). 2017 and 2018 have years of drought, which made the results difficult to evaluate. To this drought is added the strong pressure of the wild boars which requires repairing the meadows (logic of repair rather than improvement).

Valérie transforms the milk produced by cattle: cheese, yoghurt…

The farm is innovative at least in three areas:

- the grazing management system (fast rotational grazing) and the improvement (species composition, food value) of the grasslands, through trials of several techniques of over-sowing and sowing of cereals in grassland, and testing of different equipment
- the valorization of natural areas via a partnership with public authorities and environmentalists for the management of calcareous meadows and meadows with high biological value (Natura 2000 areas)
- processing and direct marketing of milk processing products through prototyping and the production of original cheeses (6 repined or fresh cheeses, milk in cartons and yogurts) in a new workshop. The cheeses bear the name of the four children of the family: the "Petit Gabriel" (a "crottin" made from cow milk), the "tender violet" (with a young, tender and soft dough), the "Divine Valentine" (inspired by the "chaume" cheese) and the "Sacré Jonas" (inspired by the tommes of the mountains). The "Carrémenbert" (inspired by the cheese almost of the same name) and the "Vachau", the name of the stream near the farm, cooked cheese, similar to the "Comté", complete the range.

Results

Today, Jambjoule Farm employs four people full time. Optimal use of the opportunities offered by the terroir (lean meadows, limestone meadows and meadows with high biological value make it possible to improve the fodder autonomy of the farm, but the climatic hazards (drought) remains an important threat.

The processing and marketing of dairy products, lamb meat and pork (valorization of whey produced by cheese production) for direct sale on the farm and via local marketing chain ("Agricovert cooperative", etc.) makes it possible to control value chains which is essential to the profitability of the farm.

The years 2017 and 2018 having been particularly dry, the tests of grass mixtures seeding did not give interpretable results. They are to continue in 2019.

Adoption criteria

The use of rigorous monitoring and evaluation tools to quantify the technical and economic reality of the farm facilitates peer-to-peer exchanges on an objective basis. Regular confrontation of experience and practices among farmers as well as networking is important for the dissemination and adoption of innovations.

Future prospects

Various potential improvements are identified by Bernard:

- • Better adaptation of meadow mixes to the situation of each farm (need more customised mixes beyond standard solutions (ready mix));

- Need for research on grassland renewal techniques (conditions (timing, preliminary work) and adapted materials);
- Need for research on over-sowing to avoid plowing and the negative effects of plowing (reduced natural drainage of the plowed meadow, stagnation of water, rise of pebbles;
- Need for research on sensitivity to the climatic hazards of the grasslands and ways to remedy their consequences;
- Need additional references for continuous short sward grazing;
- Management of some weeds (eg rumex/sorrel).

Accumulated knowledge should be disseminated preferentially through peer-to-peer exchanges.

In terms of risk, the arrival of the wolf in Wallonia is identified as likely to complicate the task of the breeders.

Diversification for a sustainable and resilient husbandry system

Farm: **'Ferme du Buis'**
Location: **Barry, Belgium**

Background

The Boxwood farm – 'la ferme du Buis' – (mixed and dairy farming, 65 hectares of which 55 are in renting, 4 FTEs) has been transformed over the last 15 years from a conventional farm status producing for the industry (cereals, potatoes, beets) to the status of an organic farm, producing for the local market with direct sale.

Pierre Cossement and his wife Véronique set up a particularly efficient autonomous dairy production system, based on rapid rotational grazing, hay drying in barn, processing and marketing of products on the farm. The model, guided by the search for autonomy and a transversal and integrated vision of the different dimensions of the farm is innovative.

The motivation of Pierre and Véronique is mainly ethic: the search for autonomy allows to no longer participate in a destructive system. The financial aspect of their activities is therefore not the most important factor. They are in permanent reflection guided by the search for a coherence in their approach. Although they are already processing more than half of the milk produced, they are now developing a cellar project for the production of hard cheese. Their autonomy approach also has a positive impact on their investment capacity.

Summary of activities developed by the 'ferme du Buis':

- Dairy farming and processing of milk into cheese, butter, yogurt, ice cream, etc.
- Mixed and dairy farming (mainly Monbéliarde breed), milk production averages 6,500 kg of milk / cow / year
- Bed and Breakfast at the farm
- Shops on the farm
- Social integration farm

- Collaboration with the LAG / Natural Park of the Scheldt Plains, CARAH (a research and farm school), the network 'innovative farms'
- Reception of trainees
- Woofing

Detailed description

- Feed autonomy:
  - Rapid rotational pasture (24-48 hours): 30 plots for 9 months, regrowth time = 35-40 days depending on the specific flora of each plot. Sowing of aromatic plants (health and mineral supply)
  - Hay drying in barn: double roof system, partly self-built (see video https://www.youtube.com/watch?v=9QiPJ45TS0E) - storage and retrieval by hay claw
- Seed autonomy (member of the peasant seed network)
- Financial and decision-making autonomy
- On-farm milk processing (butter, beaten / raw / pasteurized milk, yoghurt and fresh cheese)
- Sale of farm products on the farm
- Social farming (integration of disabled workers)
- Testing and development of new farming techniques

Results

The drying of hay in barn, combined with rotational grazing, are important factors of autonomy that favor animal health and the quality of milk for its processing into quality dairy products.

The practices implemented have allowed:

- Improve grassland quality (species composition, food value)
- Improve the health of dairy cows (no more use of antibiotics, for example)
- Jobs creation on the farm
- Implementation of production methods that are more respectful of the environment, the animal welfare and landscape;
- Increase revenue sources through the diversification of their activities and value synergies between revenue-generating activities;

  - Get closer to the end customer by offering a quality product as part of a B2C model and thus strengthen the social links of the farm with its environment;
  - Open the farm to different audiences and rely on a broad network of partners including peers, environmental associations, schools, etc.

Adoption criteria

- The willingness and conviction of the necessary change in the mode of production and marketing (permanent approach of autonomy in reaction to the conventional system in which the farmers delegate the production, the marketing of its products ...) on the part of the farmers (motivation first of the farmer and his family)
- A favorable plot of land (land next around the farm, distributed around a concrete path)
- Regular confrontation with the experience and practices of other farmers
- A rigorous multidimensional organization: management of fences, permanent assessment of grass growth stage, dynamic management of the meadow and adaptation of livestock, efficient equipment to go quickly on all stages of hay drying (cutting, windrowing, etc.)

Future prospects

- Climate change is more likely to favor the autonomous system put in place because it is more resilient because it is more complex and more diversified. Pierre and Véronique intend to pursue their autonomy approach by adapting livestock to a more rustic system (but deploring a lack of research on animals that value dried hay in barn) and the use of adapted forage seeds, currently poorly available (hence the need to produce oneself and / or collectively, without delegation to third parties ...) and the transformation of all milk production on the farm;
- There are still a number of things to think about: place of auxiliary plants in the system and optimal season calvings to match the "milk curve" and the grass growth curve in order to get dry cows during the winter.

Automation and grassland management

Willem Farm
Location: **Joubiéval (Vielsam), Belgium**

Background

In Joubiéval, the Willem family has raised dairy cows from father to son for generations.

The farm of Jean-Claude Willem, recently transmitted to his son Jerome, has 160 ha of UAA, mainly in forage crops and mostly in permanent (80ha) and temporary (50 ha) grasslands. Small areas provide cereals (20 ha) and 4 ha of semi-sugar beet, ie 1.1 LU / ha UAA (1.3 / ha grassland). The semi-sugar beets are established after temporary meadows (10 years) and are followed for three years by cereals before being again temporary meadows.

The Holstein breed now has 165 lactating cows, 140 of which are permanently milked. The herd has also about 150 heifers and calves plus about 10 males.

In 2008 Jean-Claude and his son Jerome decide to automate all the repetitive tasks They opt for more modern installations to improve their working conditions and the well-being of their animals. They introduce a project for help to modernize their farm in order to expand the livestock.

The development plan materialized in 2010, with the construction of a new barn of more than 1,500 m², the expansion of livestock effluent storage facilities and the purchase of two milking robots.

While automating the farm, Jean-Claude and his son Jérôme also wanted to combine pasture and robot to develop the grass, important constituent of rations of dairy cows, whether in the form of preserved fodder or grazed fresh grass. Pasture grazing (wire in the front-back) was adopted to encourage cows to exit the barn. And indeed 95% of cows come out of the barn.

Temporary and permanent grasslands are fertilized as follows:

- 250 kg of mineral nitrogen in the spring +150 kg of nitrogen at each cut (average 2 cuts / year) + manure (9 tonnes or 40 kg of nitrogen) as soon as possible (January 15);
- No phosphorus intake, but lime intake on 30% of the surface each year;
- 10 tons of kainite (natural compound fertilizer) every 5 years.

The essential equipment used on the farm is in CUMA (Cooperative Use of Agricultural Equipment).

Detailed description

The innovations developed within the farm are of two complementary types: Agro-equipment for automation of repetitive tasks through the use of robots and the implementation of a successful grazing management system.

Jean-Claude Willem and Jérôme have sought to automate as much as possible the demanding work of their breeding: cleaning and scraping slurry, feeding livestock (Automatic Milk Distributor for calves, Automatic Concentrate Distributor for cows, Automatic Feed Distributor for dry cows and calves, parameterisation and monitoring by collar) and milking.

To encourage the animals to go out and graze, the rotational grazing on 1 day proved an excellent technique (attraction / appetence of the young grass). The controls associated with the machines also offer precise and remote survey of the sanitary and production parameters.

The farm was monitored in the framework of the European project "Autograssmilk".

Thanks to these different automations, the working conditions have been improved and the management of the farm is more efficient, both for the productivity of the meadows and the milk collected. Animal health is also better monitored.

Grasslands, mostly permanent, are almost all (96%) both grazed and mowed (3-4 times a year). The permanent grasslands are composed of white clover, English ryegrass, timothy grass, cocksfoot, while the temporary meadows are composed of white and purple clover, pure alfalfa, English raygrass and Italian raygrass. The duration of permanent meadows is greater than 10 years. The rotational grazing over a day (front and back wires) is preferred, it lasts about 7 months per year. The grass is ensiled and wrapped for winter storage, but hay is harvested when the weather permits.

The ration of cows, consisting mainly of grass, hay and / or silage is supplemented by cereals (3 kg per cow / day), semi-sugar beets (8kg / cow / day in winter) and grain corn (1 kg / cow / day).

Jean-Claude also practices oversowing (aggressive English raygrass and white clover) through the use of an electric seeder located at the front of the tractor, after dung removal.

In order to optimize the grazing lands of the farm, they started on a rotational grazing system, a technique inspired by a study trip to Ireland.

The automation concerns the following tasks: cleaning and scraping slurry, feed (milk / calf, concentrate, parameterized by collar) and milking (collar). Rotating pasture (1day). Remote control of production and sanitary parameters.

Results

All repetitive tasks are automated:

- Milking robots

- Robot for cleaning gratings
- Robot for forage tracking
- AMD for calves
- AFD for calves up to 9 months
- AFD for dry cows
- AFD for cows to fatten

This automation allows for less repetitive and less stressful work, which can be measured qualitatively and quantitatively. Automation provides the farmer with the levers (decision support tools) on which to act to improve his farm, allows a better health monitoring of the herd (individualized monitoring of each cow) and an improvement of the production (average of 9.080 kg of milk / cow / in 2017 (official milk control) at 40% fat and 35% protein - 2.6 milking / day). Herd turnover rate is 28%.

The use of milking robots and feed supply is common in breeding in stabling. Associated with Rotational stocking techniques, automation is perfectly compatible with grazing. If this technique was the subject, at the beginning of some trial and error, it is now perfectly controlled.

In terms of profitability, energy costs are to be monitored. They are likely to be covered in the future via a biomethanisation project.

Adoption criteria

Automation is allowed by new and well-adapted buildings. Rotational grazing requests grasslands accessible from the barn and the installation of water points. The implementation of automated systems completely changed the way of working and called for a sometimes difficult adaptation period.

The adoption / adaptation of robots requires the advice of qualified persons.

The management of the rotational grazing is based on the herbometer, which becomes useless after three years.

The adoption of innovation requires an open mind to challenge itself to regularly analyse its operating system. Automation provides a significant amount of data that needs to be mastered.

Future prospects

The possible improvements concern:

- an optimal feeding of the animals to better respect the feed cycles of the latter, in particular via the use of feeding robot contained in each batch of cows;
- Continuous improvement of animal hygiene, reduce the use of antibiotics;
- A reduction of the energy bill via probably the realization of a biomethanisation project.
- The price of milk paid to the farmer (€ 0.39 / litre included VAT) remains just above the cost of production. This price is therefore still a threat for Walloon dairy farms. The milk produced is currently delivered to a dairy, but could in the future fuel a collective project.

Threats and risks relate more to the decline in meat consumption, societal pressures on agricultural activity and low indexation of agricultural prices.

In addition, studies evaluating the sustainability of grassland farming involving pasture and robots should be continued.

Westerwold ryegrass as companion crop in establishment of temporary grasslands
Jakub Gorączka, Gulcz, Wielkopolskie Voivodship

- **Background**

Jakub Gorączka runs his family farm in Gulcz, Wielkopolska Voivodship.

Basic data on a farm are presented below:

Annual Work Unit 4
Agricultural Area : 70 ha UAA
- Main forage area: 59 ha
- Arable land area: 30 ha
- Permanent grassland area: 30 ha
- Temporary grassland area: 10 ha

ANIMAL PERFORMANCE
- Dairy cows: 60
- Total livestock units: 95 LU
- Milk production per head: 8750 (l/year)

Farm is located along river Noteć Valey what creates unique opportunities for using natural, permanent grassland area for cattle production. This environment is used by a farmer in the development of his dairy production. His strategy is to get the most fodder out from his permanent and temporary grassland. In opposition to the most popular model of milk production based on maize silage Jakub decided to change proportion of his TMR and increase volume of grass silage in diet. The share of grass sward in TMR feeding system is as much as 70% on the farm, while not more than 50% is typical of the country.

Detailed description

To achieve his goals farmer decided to use Westerwold ryegrass (annual type of Italian ryegrass) as a companion (cover) crop while establishing a new temporary grassland instead of cereals such as oats or barley. Different varieties of westerwold ryegrass are used by the farmer to enhance the positive effect of leys productivity in the sowing year.

Results

The main results of the innovation are:

- Increasing grassland DM yield
- Improving forage quality and feeding vaule
- Reduced costs of milk production in comparison to TMR based on maize production

Milk yield is set up by farmer on the level of 8 700 litres of milk per year what seems to be low if we look at very intensive models of production and yields like 12 000 l. However cows are much healthier and live longer so their life production is similar to intensive ones but costs of production are probably lower by even 20%.

Adoption criteria

Many Polish farmers are afraid of investing in grassland productivity enhancing because of the high risk of failure. It is highly noticable in the Wielkopolskie voivodeship, where maize is commonly cultivated. Although westerwold ryegrass is a highly productive grass, comparable to maize, having even better feeding value, farmers are not really convinced about that and they generally prefer to cultivate maize than grasses.

Future prospects

Farmer is still looking for a better ways of grassland management. It is the best solution for him taking into consideration natural environment of Noteć River Valley. His goals is to eliminate maize silage from the diet and promote his milk as one produced from grassland only.

Sowing grasses and legumes across.

Jerzy Kokociński Farm, Snowidowo

Wielkopolskie Voivodship

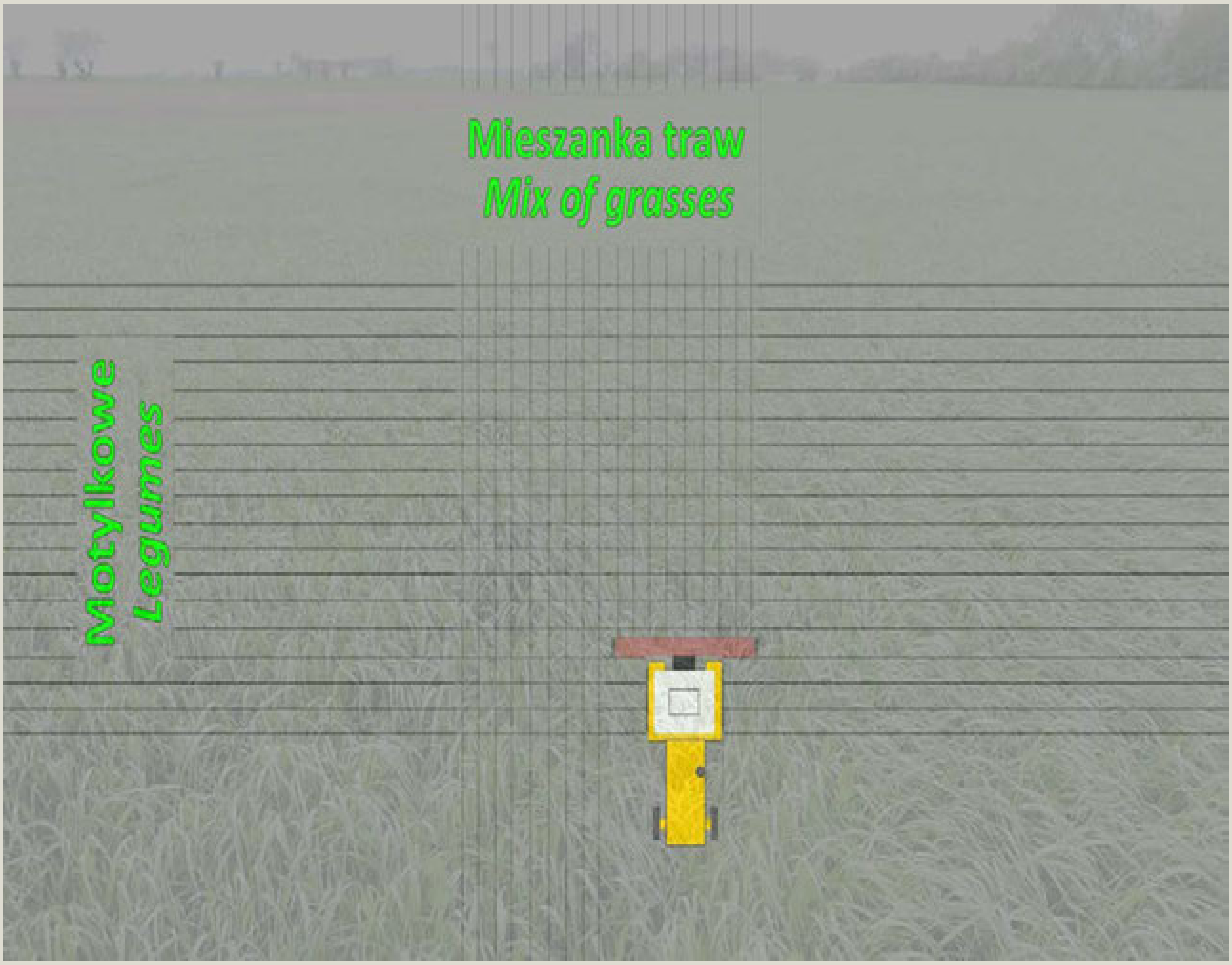
Background

Jerzy Kokociński has taken over family the farm from his parents in low in 1986. Farm was then 16 ha big with few cows and few pigs. Since then he was developing this farm and today he has 70 dairy cows and about 150 heads of cattle in total. His ambitious are growing and he would like to continue this development. It is important for him that having good successors he can manage their sailboat and his sons are blowing into sails.

Average annual milk yield is today around 11 000 l however in previous years it used to be even 12 500 l. it obviously depends on quality of grass which is lower this year as a result of lack of rain. They are managing around 100 ha of agricultural land. 50 ha is our own and 50 ha is rented. Rented land consists mainly of grassland of different quality. To improve this land they are making either full recultivation or they are over sowing a plot if full cultivation is not possible. If a plot is of adequate size and shape we are sowing grasses and legumes across.

Detailed description

Seeds of grasses and legumes are purchased and sown separately every 2-3 years. The sowing rate is 25 kg of grasses and 17 kg of legumes per hectare. Sowing grass and legumes seeds separately, perpendicular to each other in order to obtain uniform grass-legume sward. There is a high share of legumes in the sward, which amounts to 40% or even 50%. Sowing grasses and legumes together should guarantee obtaining uniform grass-legume sward.



Results

The main results of the method used by the farmer are:

- regular distribution of the sown seed on the soil surface
- better rooted plants,
- less need for nitrogen fertilization,
- less need for buying mineral fertilizers,
- high yield – 15 tonnes of dry matter per hectare,
- homogenous haylage with constant 18% protein content,
- lower usage of concentrate per cow

Adoption criteria

Innovation adopted by Jerzy is very easy to adopt by other farmers. However its application depends mainly on a size and shape of plot in question. As Jerzy said during science – practice meeting: …You have to be always rational. You have to always consider if certain solution is rational and worth undertaking…

Future prospects

Farmer for the time being is satisfied with results he has obtained from his innovation regarding optimal management of his grassland based on sowing across grasses and legumes. As we can see from a movie attached to this case study his grassland is of very high quality, what is also confirmed by high level of milk production. The main concern of farmer is economics. He is not satisfied with a milk price offered by dairy company where he is supplying his milk. He knows that he has still look for other methods of cost reduction and scale increase.

The use of short-term and highly productive grass species on permanent grasslands in order to increase the yield of dry matter of grass per hectare and improve botanical composition of the sward.

Jerzy Kostrzewa Farm, Śniaty

Wielkopolskie Voivodship

- **Background**

Jerzy Kostrzewa has taken over family the farm from his parents as it was 20 ha big with few cows, few pigs and traditional crop production. Today farm is 106 ha big with 230 dairy cows of 10 500 l annual milk production per cow and is solely focused on dairy business. Such growth was driven by external economic and market factors as well as farmer's own ambitions, skills and knowledge on dairy trends in Poland and in Europe. Simple getting the same profit, not mention profit growth, from agriculture production in Poland after transition requires an increasing volume of production, improving its effectiveness and concentration on the chosen production segment. Farm growth in dairy production, apart from investments in buildings and technology, required increasing farm area to produce feed for cows as close as possible. Mr. Kostrzewa was able to purchase some land around his farm but he was also forced to get the best use of land which was available to him. Apart from 83 ha of arable land which is intensively used for grain and maize production farm owns 23 ha of permanent meadows located along local river. Comparing the number of cattle on a farm (344,5LU) to farm size 106 ha we can immediately see a challenge. Each piece of land has to be used as good as possible. Where for arable crops it is relatively easy to reach it is very difficult in case of grassland.

- **Detailed description**

As mentioned above farmer owns 23 ha of permanent grassland along Obra valley. It is one of a few subregions of Wielkopolska with access to grasslands creating certain possibilities for dairy farms. The original meadows consists of following species: Lolium perenne 20%, Festuca pratensis 10%, Festuca arundinacea 15%, Phalaris arundinacea 15%, Alopecurus pratensis 5%, Poa pratensis 5%, Festuca rubra *10%,* Deschampsia caespitosa 2%, Trifolium pratense 5%, herbs and others 8%. This composition differs from place to place depending mainly on a soil quality and water level . This grasslands are used intensively by 3 time cutting per year. To find the best way of his grassland management farmer decided to make an experiment under supervision of Poznań University of Life Science. It is worth noted that at that time Jerzy Kostrzewa was student of this University and was completing his Msc thesis based on this experiment. In seasons 2015 and 2016 he divided his grasslands into 3 parts. One was left as original to see results of the other two trials. Second one was recultivated by oversowing existing grassland with a specially dedicated mixture of grasses and legumes. The third one was based on a full cultivation and setting a new composition based on following species: Festulolium 19%, Dactylis glomerat 9,5%, Festuca arundinacea 19%, Bromus inermis 4,75%, Lolium perenne 4N mid late 9,5%, Lolium perenne 4N mid early 4,75%, Lolium perenne 2N 4,75%, Lolium hybridum 4N 4,75%, Lolium westerwoldicum 4N 4,75%, Lolium multiflorum 4N 4,75%, Lucerne 9,5%, Trifolium hybridum 5%.

Results

The best results obtained from this experiment were for the version with full cultivation. The volume of grass production from this trial was 21,9 higher in comparison with over sowing and 85,6% higher in comparison with untouched, original grassland. Not only the volume of production increase but also quality of feed obtained. Concentration of protein for full cultivation increased by 20,4% in comparison with over sowing and 45% in comparison with original meadow.

The only shortcoming of full cultivation was that in a dry year which comes in 2018 the production results were worsened in comparison to the other two plots.

- **Adoption criteria**

Results of Jerzy Kostrzewa experiment can be directly adopted by other dairy farmers along Obra river who own permanent grassland of similar nature and conditions. However we would highly recommend to adopt farmer's approach rather than ready to go solution. To introduce innovations Jerzy followed certain steps like:

- Learning about his habitat conditions
- Considering several solutions (grass composition, method of cultivation, etc.)
- Investing some time in field tests of different solutions
- Choosing the best one for him
- Cooperating with science

- **Future prospects**

Farmer for the time being is satisfied with results he has obtained from his innovation regarding optimal management of his grassland based on full cultivation and dedicated mixture of short-term and highly productive grass species. The main threat for time being is that in a very dry year full cultivation of grassland can result in a quite large decrease in grass production. With incoming climate changes it may cause a specific challenge for a farmer.

Presently Mr. Kostrzewa is considering how to solve the other issues on a farm which is too small milking system (2*7) regarding the number of cows on the farm. Milking time reaches 8 hours per day and requires 3 full time members of staff. Mr. Kostrzewa is considering installing 4 milking robots which he thinks would shorten milking time, reduce costs of labour and increase yield by 2 litres per cow per day.

The other innovation would be constructing biogas plant to use manure from the farm. With a high number of animals, limited farm size and environmental restrictions manure management needs to be optimised as well.

Pivot irrigation system on temporary grasslands.

Michał Kaczmarek, Uścikowo

Wielkopolskie Voivodship

- **Background**

Michał Kaczmarek runs family farm in Uścikowo, Wielkopolska Voivodship. Today farm is 63 ha big with 130 dairy cows of 8 600 l annual milk production per cow and is solely focused on dairy business. Farmer process about 20% of milk produced on a farm into fresh dairy products like cheese, yogurt, cream or butter. The short term objective of Michał is to increase number of dairy cows from 130 to 300. To achieve this farmer has decided to build a new, innovative cowshed equipped with robots.

Such a growth is driven by external economic and market factors as well as farmer's own ambitions, skills and knowledge on dairy trends in Poland and in Europe. Simple getting the same profit, not mention profit growth, from agriculture production in Poland after transition requires increasing volume of production, improving its effectiveness and concentration on chosen production segment. Farm growth in dairy production, apart from investments in buildings and technology, required increasing farm area to produce feed for cows as close as possible.

Mr Kaczmarek owns only 63 ha of land including 40 ha of temporary grassland and 23 ha of maize and grain. Farmer's strategy at the moment is to increase area and production of grass and to purchase maize on local market. This strategy is based on situation where it is relatively easy to buy maize or maize silage from local market whereas it is rather difficult if not impossible to purchase good quality of grass. The other important issue is lack of sufficient rain fall during the year to produce high quality of grass in large quantities.

- **Detailed description**

To achieve his goals farmer decided to install a pivot irrigation system. He was advised by a private consultant as far as technology is concerned. His system in comparison to other systems do not require much labor and is very easy to manage.

A drilled well (200 meters deep) was dug as a source of water for irrigation. Three machines are used to irrigate three separate grasslands that have different location, size and shape. The parameters of every rampe pivot irrigation are adopted to specific agricultural plots.

Apart from irrigation technology farmer tested several garssland mixtures which would give the best production results being irrigated.

The decision when to irrigate is always underatken by farmer himslef based on his visual evaluation of plants and soil.

- **Results**

The main results of the innovation are:

- Longer time of having temporary grassland on one plot – this time has been extended from 4 to 6 years
- Less costs of cultivation
- Higher production of grass – farmer cuts his grassland even 5 times per year
- Better quality of grass – all spices are present in mixture during all 6 years of its life

Having this innovation allows farmer to implement his strategy based on increasing of milk production on a farm and substituting maize with grass.

- **Adoption criteria**

Results of Michał Kaczmarek innovation can be directly adopted by other dairy farmers in Wielkopolska. This may be an important development as level of ground water is going down as a result of rain shortages in this region. Water in future will be probably most limited factor in agriculture production. We can already see irrigation of vegetables, maize, potatoes plantations here.

- **Future prospects** of the innovation development from the farmer point of view: What can still be improved? How can it be disseminated? What are the threats?

Farmer for the time being is satisfied with results he has obtained from his innovation regarding irrigation. He is now focused on a new investment in a very modern and innovative cowshed allowing him to icrease production up to 300 dairy cows. However in this sence, investiong a lot of many in technology and buildings, his innovation if feed production is of a crucial importance for the farm economy.

Slurry tank equipped with a drag hose unit on grasslands.

Renata Matysiak, Puszczykówiec

Wielkopolskie Voivodship

- ## Background

Renata Matysiak runs her family dairy farm together with her husband and two sons. Farm is purely specialized in production of milk. At the moment there are 240 milking cows with average milk yield of 10 500 liters per year. Farm is still growing and being modernized. Farm has to provide income for three families as Renata's sons has already set up their own. In recent years farmers has invested a lot in a new and modern technologies and machines and are continuously increasing number of cows. For some years they have reached level of 11 500 liters of annual milk yield. In recent month they have also decide to move into milk production from non GMO feeds. All these developments costs a lot of many and as farmers underline milk price is not sufficient and satisfactory taking into account their efforts and money invested. In such economic conditions it is very important to optimize all processes of milk production on a farm. As we can see from a farm structure permanent grassland area constitutes very important part of animal diet on this farm. Hence it is crucial to get the best possible production of grass in a sense of both quality and quantity. It is also important that grassland is located 16 km from a farm and there are no easy options to buy agricultural land closer to the farm. The other issue is quite large animal production on a farm providing large amount of manure to be used as a fertilizer. All these factors resulted in innovation described in next section.

- **Detailed description**

Innovations is based on a piece of equipment which is slurry tank equipped with a drag hose unit. This particular equipment has been carefully selected based on a following factors:

- objective and need of farmers to reduce costs of production
- getting most production of high quality grassland
- volume of manuer production on a farm
- distance to grassland
- environment restrictions
- social issues related to bed smell and negative people reactions to this problem

Before concrete equipment was selected farmers tested different machines provided by machine dealers. Finnaly a slurry tank equipped with a drag hose unit was selected as the best option.

Results

The main reason was that manuer is not spread over the grass but goes directly into ground. Very often, epsecially with a hot wheather, direct spreading of manuer on a young grass was burning it. Using drag hose has completely eliminated this problem. Farmers are using this equipment 3-4 days after cutting grass which gives a very strong kick for a new grass to grow. The production of grass has improved by about 20% after applying new technology. New tank is big enough to manage manuer management on a quite large area of pernament grassland located 16 km from a farm. The social problem of a bed smell has been also eliminated as manuer goeas into ground. Having more grass of better quality resulted in a costs reduction. At the moment cows give around 25 litres of milk from forage. It is crucial for farm economics as farmers have decided to go into non GMO feed which means higher costs of concentrates.

Adoption criteria

Innovation applied by Matysiak Farm can be easily adopted by other farmers, especially ones who have significant amount of grassland used in their animal diet and a large amount of manure to be spread and used as a fertilizer. It is however always recommended to consider different options and make field test before a farmer choose a specific piece of equipment. Farm machines are very expensive and it is also highly recommended to share these costs among a group of farmers. Matysiak family was trying to organize such group for their slurry tank but mentality of polish farmers does not help such ideas.

Matysiak case shows that with very tiny margin in dairy production and very high costs of investments it is crucial to take care of all details and process and go towards what we call precise agriculture.

Future prospects

Farmer for the time being is satisfied with results he has obtained from his innovation regarding optimal management of his grassland and manure management.

Presently Matysiak familly is considering how to solve the other issues on a farm which is too small milking system (2*5) regarding the number of cows on the farm and small area of cow sheds. They consider investement into new cow shed and milking robots.